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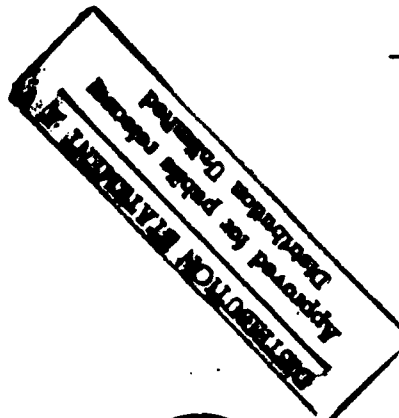
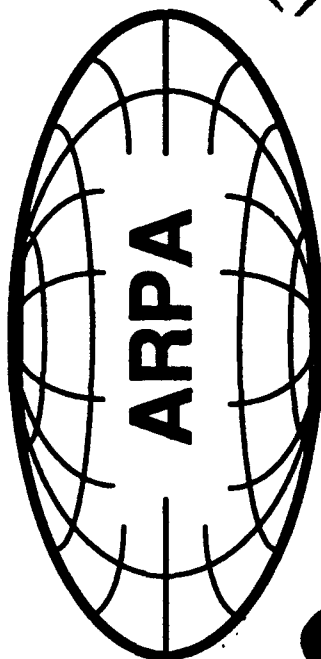
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DIRECTORATE FOR FREEDOM OF INFORMATION
AND SECURITY REVIEW (OASD-PA)
DEPARTMENT OF DEFENSE

FY 1995 Congressional Submission RDT&E Descriptive Summaries



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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Date: February 1994

PE Title: Defense Research Sciences

Budget Activity: 1. Basic Research

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
CCS-02 Information Sciences	47,698	33,677	24,322	26,030	31,628	31,623	32,300	Continuing	Continuing
ES-01 Electronic Sciences	34,763	28,853	41,934	42,232	40,835	39,560	40,333	Continuing	Continuing
MS-01 Materials Sciences	26,192	23,927	21,450	21,981	20,601	24,262	24,753	Continuing	Continuing
TOTAL	108,653	86,457	87,706	90,243	93,064	95,445	97,386		

B. (U) BRIEF DESCRIPTION OF ELEMENT: The Defense Research Sciences program element is budgeted in the Basic Research Budget Activity because it provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military, national security and commercial applications. It supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information, electronic and materials sciences.

(U) The Information Sciences project supports the scientific study and experimentation that is the basis for more advanced knowledge in software technology, intelligent systems technology, human-computer interaction technology, facets of microelectronic sciences, and varied aspects of high performance computing.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Date: February 1994

Budget Activity: 1. Basic Research

(U) The Electronic Sciences project explores and demonstrates new technical options for future electronic and optoelectronic devices, circuits, and processing. It focuses on the transmission, gathering and processing of information at a substantial increase in performance and cost reduction per function.

(U) The Materials Sciences project concentrates on the development and exploitation of biologically-derived materials, biosensors for battlefield trauma care, and high power/energy density power sources. It encompasses research on disposal of toxic chemical waste and waste source reduction related to manufacturing processes.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Project Number: CCS-02 Date: February 1994
PE Title: Defense Research Sciences Budget Activity: 1. Basic Research

A. (U) RESOURCES: (\$ In Thousands)

Project: Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
CCS-02 Information Sciences	47,698	33,677	24,322	26,030	31,628	31,623	32,300	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in Information Sciences related to long-term national security and commercial needs.

(U) Software technology develops advanced concepts for methods and tools to produce high assurance software, language concepts that facilitate the rapid specification and evolution of systems; and techniques to manage complex structured data objects in larger heterogeneous, distributed information systems. Intelligent systems technology focuses on advanced techniques for knowledge representation, reasoning, and machine learning to enable computer understanding of spoken and written language and to advance methods for planning, scheduling, and resource allocation. Human-computer interaction technology focuses on design methods and enabling technology for more natural interaction between people and computers. Microelectronic science calibrates fundamental concepts to produce reliable, testable, and high performance design. High Performance Computing (HPC) science generates concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Project Number: CCS-02 Date: February 1994
PE Title: Defense Research Sciences Budget Activity: 1. Basic Research

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed an initial distribution of a prototype persistent object base (POB) to sites using electrical, mechanical and software design tools.
- (U) Application of a shared object base to a concurrent engineering support system for POB completed.
- (U) Proof of correctness for a substantial actual VLSI processor chip was completed.
- (U) Demonstrated viability of modular interfaces formalism in software foundations.
- (U) Demonstrated intelligent mechanisms for visualization of information and the usefulness of speech language recognition technology in realistic application domains for interactive problem solving under human computer interface.
- (U) Developed and demonstrated improved mechanisms for rapidly constructing and evolving individual modules; and applied several languages to support architectural definition and prototyping for integrated environments.
- (U) Fully automated machine translation using statistical modeling methods with 70 percent comprehension.
- (U) Developed concepts for language to specify software architecture and interconnection amongst modules in software systems, for component-oriented approaches to large-scale software systems, for reuse of aspects of systems architecture and design, and for active vision and vision-guided navigation.
- (U) Demonstrated close integration of object-oriented database and programming language technologies.
- (U) Developed approaches combining model-based vision with neural networks, and tools that can verify adherence to formalized interface specifications and then demonstrated approaches on standard protocols.
- (U) Demonstrated new fault tolerant interconnection techniques which can be implemented on scalable parallel systems and constructed high performance libraries which allow execution across multiple applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: CCS-02

Date: February 1994

Budget Activity: 1. Basic Research

(U) FY 1994 Planned Program:

- (U) Develop benchmark problems, metrics, and test data sets for advanced research in information sciences. (\$2.4M)
- (U) Develop advanced concepts for machine learning, automated reasoning, and knowledge representation for spoken language understanding, written language understanding, and large-scale planning, scheduling, and resource allocation methods. (\$1.7M)
- (U) Explore the utility of advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. (\$5.8M)
- (U) Develop design concepts for interactive, dialogue-based human computer interaction. (\$4.3M)
- (U) Develop process model approaches for prototyping large-scale software systems. (\$1.0M)
- (U) Develop advanced concepts for software understanding, high assurance, and software system composition. (\$5.2M)
- (U) Develop advanced concepts for heterogeneous, distributed software system architectures and tools to support construction and maintenance of software systems. (\$2.9M)
- (U) Develop design concepts of advanced components needed for highly reliable computing systems including mobile, high performance, and graphical systems. (\$6.1M)
- (U) Develop advanced concepts for high performance libraries to support multiple parallel architectures and integrated with compiler technology. (\$4.3M)

(U) FY 1995 Planned Program:

- (U) Provide Internet access to benchmark problems, metrics, and test data sets and conduct experimental evaluations involving multiple intelligent systems and software technologies. (\$2.0M)
- (U) Develop initial prototype of reusable machine learning, automated reasoning, and knowledge representation methods for spoken language understanding, written

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: CCS-02 Date: February 1994

PE Title: Defense Research Sciences

Budget Activity: 1. Basic Research

language understanding, and large-scale planning, scheduling, and resource allocation methods. (\$1.6M)

- (U) Experimentally evaluate advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. (\$5.9M)
- (U) Develop initial tool kits for interactive, dialogue-based human computer interaction. (\$4.4M)
- (U) Develop initial language-based methods for software understanding, high assurance, and software system composition. (\$4.7M)
- (U) Develop initial prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. (\$3.8M)
- (U) Experimentally evaluate library research which supports multiple parallel architectures. (\$1.9M)

D. (U) WORK PERFORMED BY: University of Southern California, Information Sciences Institute, Marina Del Rey, CA; Stanford University, Palo Alto, CA; Massachusetts Institute of Technology, Cambridge, MA; University of California at Berkeley, CA; Carnegie Mellon University, Pittsburgh, PA; University of Massachusetts at Amherst, Amherst, MA; and Northwestern University, Evanston IL.

E. (U) RELATED ACTIVITIES: The technologies developed in this project provide the foundation for further developments in PE 0602301E, Computing Systems and Communications Technology. There is no unnecessary duplication of effort with other Department of Defense research activities.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E Project Number: ES-01 Date: February 1994
 PE Title: Defense Research Sciences Budget Activity: 1. Basic Research

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ES-01 Electronic Sciences	34,763	28,853	41,934	42,232	40,835	39,560	40,333		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function. Research areas include new electronic device and circuit concepts, innovative optical arrayed interconnects and smart pixels, optical memory research, artificial neural network (ANN) research, and microelectromechanical systems (MEMS) technology. This basic research project creates the vital new concepts for advanced electronic, optoelectronic, and MEMS components to meet future DoD needs.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

- (U) FY 1993 Program:
- (U) Developed diode laser amplifier arrays.
 - (U) Developed coupled, quantum-well optical switches.
 - (U) Demonstrated blue-green diode laser.
 - (U) Fabricated nonlinear polymer device structures with molecular beam epitaxy (MBE).
 - (U) Initiated development of neural network techniques for temporal processing, nonlinear adaptive filters, and synthesis of 3-D images from 2-D views.
 - (U) Demonstrated low cost, long-wavelength infrared focal plane arrays operating at 77°K using low cost Gallium Arsenide (GaAs) substrates.
 - (U) Demonstrated feasibility of free-space optical interconnect.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: ES-01

Date: February 1994

Budget Activity: 1. Basic Research

- (U) Developed conformal printing, 3-dimensional machine technologies, and shared multi-project fabrication runs for the manufacturing of microelectromechanical systems (MEMS).
- (U) Determined the utility of indium phosphide (InP) heterojunction bipolar transistor (HBT) technology for very wide bandwidth analog-to-digital (A/D) converter applications.
- (U) Demonstrated quantum dots grown in nanochannel glasses.
- (U) Measured optical constants of Gallium Arsenide (GaAs), as a function of temperature and strain.
- (U) Demonstrated nanoelectronic shift register.
- (U) Fabricated lateral resonant-tunneling device.

(U) FY 1994 Planned Program:

- (U) Determine applicability of lattice gas computing architecture to nanoelectronics. (\$1.2M)
- (U) Demonstrate self-assembled molecular wiring of 10 nanometer lengths. (\$.7M)
- (U) Deliver process simulator computer program with two-dimensional capability for GaAs and silicon-based devices. (\$2.0M)
- (U) Demonstrate fabrication of abrupt semiconductor interfaces using limited reaction processing. (\$1.0M)
- (U) Fabricate array of 10 nm channels with 15 nm spacing using nanochannel glass. (\$.5M)
- (U) Demonstrate compressed-size, two-dimensional edge detector using nanoelectronics. (\$1.0M)
- (U) Demonstrate lateral resonant tunneling. (\$1.3M)
- (U) Explore applicability of single electron transistors to ultra-dense logic and memory. (\$1.0M)
- (U) Demonstrate nanometer scale critical dimensions of devices grown on patterned substrates. (\$.5M)
- (U) Explore SiGeC composition for use in silicon-based nanoelectronics. (\$.4M)
- (U) Demonstrate patterning using self-assembled monolayers. (\$.3M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: ES-01

Date: February 1994

Budget Activity: 1. Basic Research

- (U) Demonstrate 10X reduction in ultra-low-power laser size. (\$2.0M)
 - (U) Demonstrate optical interconnects for chip-to-chip and on-chip. (\$3.0M)
 - (U) Develop semiconductor laser diodes with minimum relative intensity noise (RIN) for analog modulation. (\$1.0M)
 - (U) Investigate charge transport across quantum well interface for high speed photonic operation. (\$.953M)
 - (U) Investigate crystalline and quantum well nonlinear polymer devices. (\$1.0M)
 - (U) Develop dynamic neural networks for temporal processing applications. (\$.7M)
 - (U) Design and initiate development of neural network techniques and associated analog network hardware for image preprocessing and feature extraction. (\$1.3M)
 - (U) Determine theoretical performance capabilities and limitations of specific neural network architectures. (\$.7M)
 - (U) Develop microsensor CAD/CAM and process simulation tools and initiate multi-project, common fabrication infrastructure. (\$8.3M)
- (U) FY 1995 Planned Program:
- (U) Develop voltage measurement capability suited to nanoelectronics (better than 100 nanometer spatial resolution and 50GHz temporal resolution). (\$.5M)
 - (U) Demonstrate power reduction by a factor of five through the combination of nanoelectronics and conventional devices. (\$.7M)
 - (U) Explore compressed circuitry using multi-valued logic and nanoelectronics. (\$2.0M)
 - (U) Demonstrate utility of nanochannel glasses in fabricating nanoelectronic structures. (\$.5M)
 - (U) Demonstrate improved process control of molecular beam epitaxy (MBE), controlling temperature to within 2 degrees and thickness to within 1 nm. (\$1.5M)
 - (U) Utilize nanostructures for high resolution electron and ion-beam technology. (\$3.5M)
 - (U) Determine optimum materials system for fabricating silicon-based nanoelectronics. (\$2.8M)
 - (U) Demonstrate three-terminal lateral resonant tunneling transistor. (\$1.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Project Number: ES-01 Date: February 1994

PE Title: Defense Research Sciences

Budget Activity: L. Basic Research

- (U) Demonstrate feasibility of magnetic memory with nanometer scale devices. (\$1.4M)
- (U) Develop chemical self-assembly techniques for electronically active materials. (\$0.5M)
- (U) Develop bright blue LED arrays. (\$2.0M)
- (U) Demonstrate capable smart pixel arrays. (\$2.9M)
- (U) Demonstrate optical interconnect for shared memory application. (\$2.834M)
- (U) Insert lift-off technology into semiconductor module processing. (\$1.5M)
- (U) Develop functional optoelectronic modules. (\$3.0M)
- (U) Apply dynamic neural networks to speech and handwriting recognition tasks. (\$1.0M)
- (U) Develop and demonstrate prototype analog neural network hardware for image preprocessing and feature extraction. (\$1.5M)
- (U) Develop high-yield, high-uniformity fabrication processes for microelectromechanical system (MEMS) devices and merge MEMS with related fabrication technologies in optics, optoelectronics and microwave devices. Initiate low-bandwidth, large-scale MEMS-based sensor networks. (\$7.8M)
- (U) Initiate low-power electronics technology. (\$5.0M)

D. (U) WORK PERFORMED BY: Analog Devices, Cambridge, MA; Stanford University, Palo Alto, CA; California Institute of Technology, Pasadena, CA; Texas Instruments, Dallas, TX; University of Michigan, Lansing, MI; University of California at Santa Barbara, CA; Cornell University, Ithaca, NY; Massachusetts Institute of Technology, Cambridge, MA; Yale University, New Haven, CT; Optivision, Palo Alto, CA; Rockwell International Science Center, Thousand Oaks, CA; Naval Research Laboratory, Washington, D.C; and David Sarnoff Research Center, Princeton, NJ.

E. (U) RELATED ACTIVITIES: Efforts in this project are coupled to the Services' program through use of Service agents, annual DoD-wide program reviews, and review by the Advisory Group on Electron Devices (AGED). These activities assure that no unnecessary duplication of effort occurs. This project provides a research base for 0602712E, MPT-02, Electronics Processing Technology.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

Date: February 1994

Project Number: ES-01

PE Title: Defense Research Sciences

Budget Activity: 1. Basic Research

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: MS-01

Date: February 1994

Budget Activity: 1. Basic Research

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MS-01 Materials Sciences	26,192	23,927	21,450	21,981	20,601	24,262	24,753		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project is concerned with the development and exploitation of: biologically-derived materials for use as electron source structures; magnetic composite materials and therapeutic spatial light modulators; biosensors for battlefield trauma care; development of high power/energy density electrochemical power sources (batteries and fuel cells). Other areas of focus are research on the disposal of toxic chemical wastes, waste source reduction for DoD-relevant manufacturing processes and training of DoD personnel in hazardous waste management; and development of advanced algorithms and associated technologies for detecting and identifying targets hidden in foliage.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed performance testing of solid state batteries previously delivered in FY 1992.
- (U) Initiated contracts for toxic waste source reduction for DoD-relevant manufacturing processes.
- (U) Produced prototype primary solid state battery.
- (U) Initiated construction of pilot plant for safe destruction of toxic military chemical wastes.
- (U) Developed novel methods for automatic target recognition and classification using wavelets, a new signal representation method, and other advanced mathematical techniques.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: MS-01

Budget Activity: 1. Basic Research

Date: February 1994

- (U) Initiated a program to develop elevated temperature operation of laser diodes to pump solid state lasers and two micron laser sources for infrared countermeasures.

(U) FY 1994 Planned Program:

- (U) Electrochemistry (\$15.5M). Develop high energy density/power density electrochemical power sources for a variety of military applications. Utilize supercritical water oxidation to destroy DoD toxic wastes.
 - (U) Demonstrate high efficiency direct oxidation fuel cell power module.
 - (U) Demonstrate prototype rechargeable solid state military battery. Deliver 20 prototypes.
 - (U) Construct supercritical water oxidation (SCWO) processor for destruction of toxic wastes. Demonstrate agent simulant destruction using SCWO technology.
 - (U) Initiate a hazardous substance research centers program to train DoD and DOE personnel in hazardous waste management and other related specialties.
 - (U) Initiate a program to develop a logistic fuel cell for mobile electric power. Evaluate fuel reformer catalysts and processor components.
- (U) Biotechnology (\$5.1M). Utilize biological technologies to enhance various aspects of military medicine.
 - (U) Initiate program in medical technology concerned with developing medical sensors and the use of advanced information technologies to enhance battlefield trauma care.
 - (U) Demonstrate binding affinity, reagent stability, and cellular uptake of oligonucleotide reagents for infections.
- (U) Biomedical (\$2.0).
 - (U) Develop anatomy simulation in virtual environments for training of military surgeons in surgical procedures for battlefield casualties.
- (U) Optical materials (\$1.4M). Develop elevated temperature laser diode arrays.
 - (U) Demonstrate nondestructive read out and selective erasure for holographic data storage.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: MS-01

Date: February 1994

Budget Activity: 1. Basic Research

(U) FY 1995 Planned Program:

- (U) Electrochemistry (\$10.9M). Concentrates on use of logistic fuels (hydro-carbon based) in advanced energy sources (fuel cells).
 - (U) Evaluate novel logistics fuel catalysts, electrolytes and electrodes.
 - (U) Develop logistic fuel cell components and demonstrate near ambient temperature operation.
- (U) Biomedical (\$10.6M).
 - (U) Further modular development on the personnel status monitor (PSM) to produce secondary sensors of non-invasive blood chemistries; initial miniaturization of power supply and electronic packaging; involves field testing and evaluation. Development of field medical communication network of cellular and regional control units; integration of small antenna design; asynchronous transfers mode protocol and electronic firmware and software development. MS-01 represents component and modular additions to the PSM in development in PE 0602712E project MPT-07.
 - (U) To develop advanced monitoring for the critical care pod and horizontally integrate with telecommunications throughout the battlefield over wireless networking.
 - (U) Develop miniaturized direct digital imaging technologies; begin electronic miniaturization and packaging.
 - (U) Develop battlefield surgical simulation for injuries to the torso, including complex physiologic representation.
 - (U) To continue development of virtual environment for the individual soldier in order to test and evaluate the efforts of training, equipment, etc. on the health of the soldier.
 - (U) To develop and incorporate advanced manipulation and sensory feedback into a telepresence surgery system; explore methods for diminishing latency in tele-manipulation; field testing and evaluation.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0601101E

PE Title: Defense Research Sciences

Project Number: MS-01

Budget Activity: 1. Basic Research

Date: February 1994

D. (U) WORK PERFORMED BY: University of Pennsylvania, Philadelphia, PA; Massachusetts Institute of Technology, Cambridge, MA; California Institute of Technology, Pasadena, CA; GA Technologies, La Jolla, CA; International Fuel Cells, South Windsor, CT; Northwestern University, Evanston, IL; Georgetown University, Washington, DC; Sarcos Corporation, Salt Lake City, UT; Sandia Laboratory, Albuquerque, NM; and General Electric Medical R & D Center, Schenectady, NY.

E. (U) RELATED ACTIVITIES: ARPA's research in Materials Sciences, Electrochemistry and Biotechnology is coordinated within the DoD and with other federal agencies via Office of Science and Technology Policy (OSTP) Committee on Materials (COMAT), and various Director Defense Research and Engineering (DDR&E) sponsored topical workshops on advanced materials, electrochemistry and biotechnology. These activities assure that no unnecessary duplication of effort occurs.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Date: February 1994

PE Title: Computing Systems and

Budget Activity: 2. Exploratory Development

Communications Technology

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ST-01 JASON	1,240	1,240	1,227	1,218	1,203	1,190	1,178	Continuing	Continuing
ST-10* Strategic Computing	68,246	0	0	0	0	0	0	0	Transferred to ST-11 and ST-19
ST-11* Intelligent Systems & Software	38,806	68,193	93,656	107,726	116,284	144,994	144,407	Continuing	Continuing
ST-12* Advanced Quantum Electro-Optics and Electronic Warfare	8,610	0	0	0	0	0	0	0	Transferred to TT-06
ST-19 High Performance Computing (HPC)	131,730	192,157	243,700	234,575	266,300	268,060	291,535	Continuing	Continuing
ST-20* Distributed Information Systems/C3	34,352	0	0	0	0	0	0	0	Transferred to ST-11
ST-21* Software Engineering Institute (SEI)	15,635	0	0	0	0	0	0	0	Transferred to ST-22

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and

Communications Technology

Date: February 1994

Budget Activity: 2. Exploratory Development

ST-22*	Software Engineering Technology	21,814	37,550	40,223	19,562	19,205	18,678	20,250	Continuing	Continuing
ST-23	Counter Proliferation Technology	26,451	22,276	40,802	51,217	60,738	68,402	69,112	Continuing	Continuing
TOTAL		346,884	321,416	419,608	414,298	463,730	501,324	526,482		

*These projects reflect the Program Element/Project consolidation and realignment within ARPA.

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Exploratory Development Budget Activity because it funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include:

(U) ARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies to allow computer systems to function at a trillion operations per second and a billion bits per second networking to ensure availability for future defense needs. This technology will be incorporated into advanced applications to solve critical defense problems such as distributed C3 systems.

(U) The efforts funded in the Intelligent Systems and Software project focus on the development of new information processing technology concepts that lead to fundamentally new software and intelligent system capabilities. Emphases are in autonomous systems, interactive problem solving, source integration, software development, and manufacturing automation and design engineering.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and
Communications Technology

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS). SEI works to transition, introduce and promulgate modern software in the defense industry. The STARS program develops large-scale software products that have commercial as well as military capabilities.
- (U) The Surveillance Research project efforts in the Verification Readiness Program enhance the U.S. surveillance capabilities for monitoring worldwide nuclear explosions. While the Counter-proliferation Technology Program concentrates on the development of technologies for detecting the production, testing and storage of nuclear materials and weapons. This project will develop and provide demonstrations of advanced technologies that will enable the assessment of counter-proliferation options to neutralize nuclear threats.
- (U) The JASON studies support the national security community.
- (U) The programs contained in Projects ST-11, ST-19 and ST-22 reflect the Department's initiative to support dual-use technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E Project Number: ST-01 Date: February 1994
 PE Title: Computing Systems and Budget Activity: 2. Exploratory Development
 Communications Technology

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ST-01	JASON								
	1,240	1,240	1,227	1,218	1,203	1,190	1,178	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project supports the JASONS, an independent group of distinguished individuals dedicated to sophisticated scientific and technical research and analysis in support of the National Security Community. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

- (U) FY 1993 Program:
 - (U) Conducted extensive technical investigations in areas such as: advanced sensors for surveillance and strike; shallow water acoustic ASW; advanced concepts for lightweight survivable combat vehicles; advanced materials; and signal processing.
- (U) FY 1994 Planned Program:
 - (U) Continue investigations in technical problems related to the ARPA mission of supporting the Services with the development of advanced technologies, including new approaches to stealth, surveillance, communications and signal processing.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and
Communications Technology

Project Number: ST-01 Date: February 1994
Budget Activity: 2. Exploratory Development

(U) FY 1995 Planned Program:

- (U) Continue investigations involving: structural acoustics; advanced land combat vehicles; precision strike; ASW; nuclear weapon proliferation; and global surveillance and communications.

D. (U) WORK PERFORMED BY: MITRE Corporation, McLean, VA supports the JASON group.

E. (U) RELATED ACTIVITIES: Not applicable.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-11 Date: February 1994

PE Title: Computing Systems and Communications Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ST-11 Intelligent Systems and Software	38,806	68,193	93,656	107,726	116,284	144,994	144,407	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: Develop new information processing technology concepts that lead to fundamentally new software and intelligent systems capabilities. This will enable advanced information systems (involving both humans and computers) to more effectively accomplish decision making tasks in stressful, time sensitive situations and create efficient software systems supporting computer and software intensive defense systems. Major areas of technical emphasis are in: (a) intelligent systems (artificial intelligence) including autonomous systems, interactive problem solving and intelligent integration of information from heterogeneous sources; (b) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototype technology, software design tools, software reuse, and advanced software engineering environments; and (c) manufacturing automation and design engineering, including the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control and demonstrations.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated standards for reuse of knowledge among diverse systems, including Integrated Weapons Systems Databases; developed and validated standards of

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- (U) knowledge transmission; and demonstrated standards for knowledge transmission in industrial prototypes.
- (U) Integrated a number of independently developed software development tools to demonstrate the utility of integration mechanisms based on data sharing and message passing; and demonstrated tools to support the test and analysis of real time systems and integrated these tools into a software development environment.
- (U) Demonstrated robust speech recognition of dictation with 12 percent word error with a 20,000 word vocabulary, in continuous speech, independent of speaker.
- (U) Released beta version compiler for the image understanding architecture, scalable parallel computer optimized for machine vision applications.
- (U) Incorporated stereo vision into complete working autonomous systems; and developed robust systems to aid real time planning of autonomous systems.
- (U) Deployed configured data sets to R&D community to support research on image understanding, stereo vision, planning, hybrid control, and machine learning.
- (U) Developed and demonstrated agent based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control.
- (U) Developed architecture for a heterogeneous database system which integrates, interfaces, creates and maintains a single database from multiple non-interoperable intelligence community databases.
- (U) Developed a corresponding machine learning strategy to enable computers to learn specific user interaction characteristics and knowledge based decision aids to support the rapid construction of multiple battle plans.
- (U) Developed improved message-handling algorithms, databases, evaluation techniques and algorithms for document-image processing and installed text data extraction system for Drug Enforcement Agency (DEA) investigative reports.

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(U) FY 1994 Planned Program:

- (U) Develop test case scenarios and internet accessible software testbeds that typify the type of advanced information processing requirements in DoD systems such as autonomous systems, command and control, and manufacturing systems. (\$9.4M)
- (U) Experimentally evaluate the integration of multiple intelligent systems and software technologies in an autonomous vehicle. (\$.9M)
- (U) Release the beta version of the Image Understanding Environment (IUE) and develop advanced methods for vision guided navigation, cartographic modelling, and target detection and identification. (\$15.6M)
- (U) Develop initial capabilities for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. (\$12.1M)
- (U) Develop advanced real-time planning and control algorithms. (\$3.8M)
- (U) Develop knowledge-based decision aids to support the rapid construction of crisis action plans. (\$3.8M)
- (U) Develop advanced methods for information fusion, aggregation, summarization, and explanation. (\$3.7M)
- (U) Develop initial language-based methods for describing domain-specific software architecture and tools that facilitate composing a software system based on a domain specific architecture. (\$6.7M)
- (U) Develop initial advanced software environment that supports composition tool integration and software development and testing using animation techniques. (\$3.1M)
- (U) Develop fundamental evaluation and design concepts to support highly distributed, wide bandwidth information processing applications that require persistent objects. (\$3.4M)
- (U) Enhance agent based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. (\$3.2M)
- (U) Integrate persistent object base, case-based reasoning and physics-based simulation models in an integrated product/process design (IPPD) testbed. (\$2.5M)

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Budget Activity: 2. Exploratory Development

(U) FY 1995 Planned Program:

- (U) Experimentally evaluate the integration of multiple advanced intelligent systems and software technologies in multiple autonomous vehicles. (\$5.6M)
- (U) Upgrade the Image Understanding Environment (IUE) based on FY 1994 evaluations and develop prototype implementations of advanced methods for vision guided navigation, cartographic modelling, target detection and identification. (\$12.0M)
- (U) Develop initial prototype implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. (\$13.0M)
- (U) Develop initial prototype implementations of advanced real-time planning and control algorithms. (\$4.0M)
- (U) Enhance knowledge based decision aids to support the rapid construction of multiple crisis action plans. (\$10.6M)
- (U) Develop concepts and implement prototype of scalable machine intelligent algorithm for autonomous associate and assistant intelligent systems. (\$1.0M)
- (U) Design and prototype a domain specific software architecture for a weapons system crew station associate system. (\$1.0M)
- (U) Develop initial prototype implementations of advanced methods for information fusion, aggregation, summarization, and explanation. (\$5.0M)
- (U) Experimentally evaluate language-based methods for describing domain specific software architecture and tools that facilitate composing a software system based on a domain specific architecture. (\$5.9M)
- (U) Experimentally evaluate advanced software environment that supports composition tool integration and software development and testing using animation techniques. (\$4.0M)
- (U) Develop prototype to support highly distributed, wide bandwidth information processing application that require persistent objects. (\$5.2M)
- (U) Enhance the IPPD testbed to include intelligent product and process representations and a scalable framework to invoke and attach design tools for electro-mechanical systems. (\$3.0M)

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- (U) Develop information infrastructure services for manufacturing, including network access to engineering analysis and rapid prototyping services. (\$6.0M)
- (U) Experimentally evaluate agent based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. (\$7.4M)
- (U) Initiate study measuring the impact of technology aids on teacher, staff, and student performance. Train teachers in use of technology in selected clusters use model school districts (such as Val Verde & Port Hueneme) to transfer high technology concepts of use to other clusters. (\$4.0M)
- (U) Initiate development of a heterogeneous testbed for human computer interaction technology insertion for testing, evaluating and demonstrating. (\$6.0M)

D. (U) WORK PERFORMED BY: Stanford University, Palo Alto, CA; University of Southern California, Information Sciences Institute, Marina Del Ray, CA; Carnegie Mellon University, Pittsburgh, PA; Harvard University, Cambridge, MA; University of Massachusetts, Amherst, MA; Computational Logic, Inc., Austin, TX; University of California at Berkeley, CA; Teleos Corporation, Palo Alto, CA; ISX Corporation, Woodland Hills, CA; General Electric, Schenectady, NY; Martin Marietta, Denver, CO; IBM, Oswego, NY; GTE, Chantilly, VA; Honeywell, Minneapolis, MN; and Rice University, Houston, TX.

E. (U) RELATED ACTIVITIES: Builds upon the new high performance computing technologies being produced under project ST-19 in this program element.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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Project Number: ST-19 Date: February 1994

PE Title: Computing Systems and

Budget Activity: 2. Exploratory Development

Communications Technology

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ST-19 High Performance Computing	131,730	192,157	243,700	234,575	266,300	268,060	291,535	Continuing	Continuing

*Because of the consolidation and realignment of program elements and projects completed within ARPA in FY 1994, comparisons of FY 1993 to other years may be misleading without including other projects.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project develops the computing, networking, and associated software technology base underlying the solutions to computational and information-intensive applications for future Defense and Federal needs. These technologies lead to successive generations of higher performance and more cost effective systems scalable to a trillion operations per second (teraops) systems and billion bits per second (gigabits) networking, associated software technologies, advanced information infrastructure technology, and prototype experimental applications leading to national-scale efforts across the Federal government. Results will be used in other ARPA and Defense programs for experimental application to critical defense and national problems.

(U) High Performance Computing (HPC) develops software and hardware technologies leading to a scalable computing and communications technology base for systems configured over a wide performance range, from mobile handheld devices to desktop workstations to the largest-scale, highest performance systems, including embedded versions of these systems. The Scalable Computing Systems component develops, demonstrates, and evaluates for early experimental use a variety of advanced scalable parallel systems at the frontier of computing. The Microsystems component develops design tools, support environments, and infrastructure to support the research and development of advanced scalable parallel computing components and systems for large-scale

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computing systems, embedded computing systems, and wireless computing systems. Microsystems activities also support innovative system prototyping techniques in hardware and software as well as early small-scale architecture experiments leveraging scalable computing technology, micro-architectures, low-energy components and processes, optimization techniques, and advanced packaging technology. The Scalable Software component develops technologies for operating systems, programming languages, compilers, tools, and environments to enable the effective use of the new high performance computing technologies. The Information Infrastructure Software and Services component develops underlying technologies to support large, complex and distributed applications such as privacy and trust mechanisms, remote resource sharing and information security. The Information Infrastructure Application Demonstrations component develops early prototype experiments of important large-scale, distributed applications in conjunction with various Defense and Federal programs. The Networking component develops high performance networking technologies and associated capabilities. The Defense Technology Integration and Infrastructure component applies the new computing technologies to solve specific defense problems in innovative ways.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated 100 Gigaops-class systems as part of joint projects including Cray Research (T3D), Intel Corporation (Paragon), Thinking Machines Corporation (CM-5), Kendall Square Research (KSR-1), and International Business Machines (SP-1, SP-2).
- (U) Demonstrated advanced design technologies including semiconductor process representations, electromagnetic modeling tools on the HPC base, and synthesis of heterogeneous multiprocessors and testable circuits.
- (U) Developed and demonstrated low cost rapid prototyping multichip module (MCM) capability.
- (U) Completed design including packaging and cooling technology in support of embedded Touchstone demonstration.

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- (U) Demonstrated prototype scalable microkernel operating systems for systems with thousands of processing nodes that may also include multiple processors, advanced systems services, and concepts for their extension to time-constrained systems.
- (U) Demonstrated prototype transparent replication and end user trusted configuration of wide area file system.
- (U) Developed and demonstrated a prototype trusted version of the scalable microkernel operating system (TMach). Developmental evaluation for both U.S. trusted computer security criteria and European harmonized criteria.
- (U) Demonstrated high performance networking in gigabit testbeds and identified limitations for future research.
- (U) Demonstrated asymmetric networking, coupling dial-up telephone and cable television resources.
- (U) Demonstrated prototype all-optical network using wave division multiplexing.

(U) FY 1994 Planned Program:

- Scalable Computing Systems. (\$48.8M)
 - (U) Develop foundations for petaoperations (10^{15}) per second and terabits (10^{12}) systems.
 - (U) Demonstrate software and hardware compatibility between scalable commercial HPC systems and embeddable versions.
 - (U) Demonstrate scalable mass storage systems and associated system services and input/output channels.
 - (U) Develop 10 gigaflops/cu. ft. militarized, embeddable scalable computing system. Microsystems. (\$35.0M)
 - (U) Develop and demonstrate semiconductor virtual process design coupled to actual fabrication line for real-time process control.
 - (U) Enhance and demonstrate direct support of rapid prototyping of MCM technology.
 - (U) Fabricate operational sub-micron diameter vertical Field Effect Transistor (FET) for ultra high density read-only memory.

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- (U) Demonstrate 200 Mhz superpipelined processor as part of continuing architectural exploration of high performance system.
- (U) Develop and demonstrate tools and environments to support the design of low power and wireless computing systems.
- (U) Demonstrate enhanced fabrication services integrated with library management tools and extended system synthesis capabilities.
- Scalable Software. (\$27.3M)
 - (U) Demonstrate scalable libraries for Defense-critical problems, such as computational physics and image processing.
 - (U) Develop and distribute HPC software, documentation, performance measurements, and prototype applications using a wide area file system.
 - (U) Demonstrate distributed ADA on scalable HPC systems.
 - (U) Prototype HPC programming environments for standard languages like C++ and Fortran, while developing new languages like Dataflow and new environments like Visual Programming.
- Information Infrastructure Software and Services. (\$10.1M)
 - (U) Demonstrate and distribute prototype tools enabling secure communications, including Privacy Enhanced Mail (PEM) and secure extensions to remote procedure call (RPC) mechanisms.
 - (U) Develop prototype suite of advanced data storage and access tools, such as distributed and replicated file systems supporting intermittent communications, trusted and secure operations, more sophisticated access semantics, and multilevel storage management.
 - (U) Develop prototype software development environments for distributed applications.
- Information Infrastructure Application Demonstrations. (\$3.8M)
 - (U) Demonstrate initial national-level digital library for exchange of technical reports between five major universities, ARPA, and the Library of Congress.

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PE Title: **Computing Systems and**

Budget Activity: **2. Exploratory Development**

Communications Technology

- (U) Initiate, in conjunction with NSF and NASA, a broader initiative to expand library technology in the areas of information indexing, remote access, and storage management.
- Networking. (\$40.0M)
 - (U) Demonstrate C3 systems technology with scalable high performance network technology enabling full multimedia real-time information exchange using early gigabit networks.
 - (U) Demonstrate prototypes of gigabit SONET/ATM technology operating over fiber and satellite media.
 - (U) Perform initial interconnections among gigabit testbeds.
 - (U) Demonstration of all-optical Local Area Networks (LANs).
 - (U) Demonstrate medical, terrain visualization, and modeling applications on 100 Mbit and Gbit-class networks.
- Defense Applications and Infrastructure. (\$27.0M)
 - (U) Develop initial prototype of C3 and weapons systems using embeddable high performance technologies for Navy applications.
 - (U) Develop initial experimental capabilities employing advanced high performance computing technologies for Defense users.
 - (U) Demonstrate networked technologies and capabilities for education and human resource pilot projects.

(U) **FY 1995 Planned Program:**

- Scalable Computing Systems. (\$60.3M)
 - (U) Demonstrate teraops-class modules covering major models of scalable computing, spanning shared and distributed memory models and fine and coarse grain parallelism, that have the potential for being the foundation for next generation and cost-effective units in computing systems.
 - (U) Design 50-100 gigaflop/cu. ft. militarized embedded systems leveraging commercial scalable computing components and software.
 - (U) Demonstrates 10 gigaflop/cu. ft. militarized HPC system.

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Program Element: #0602301E

PE Title: Computing Systems and Communications Technology

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- (U) Demonstrate advanced technology based scalable units of replication.
- Microsystems. (\$44.7M)
 - (U) Extend network-accessible design and fabrication services to include computational prototyping concepts.
 - (U) Develop early module-level synthesis capabilities.
 - (U) Demonstrate wireless computing design environments through the design of early prototype, high bandwidth, pico cellular, and wireless access points to the wireline infrastructure.
 - (U) Continue development and standardization of process representations. Demonstrate higher levels of process optimization to include low energy initial demonstrations of micro-architectures for advanced packaging and scalable units of replication.
- Scalable Software. (\$29.7M)
 - (U) Demonstrate real-time operating system support tools for scalable, distributed HPC systems.
 - (U) Demonstrate software development environments for distributed heterogeneous systems on workstation-based tenth-scale teraops systems.
 - (U) Experimentally characterize input/output requirements for large- and small-scale computing systems on scalable parallel systems.
 - (U) Demonstrate prototype integrated HPC programming environment for Fortran and C++.
 - (U) Develop portable, real-time fault tolerant operating system software which is compatible with embeddable and commercial scalable HPC systems.
- Information Infrastructure Software and Services. (\$27.1M)
 - (U) Develop unified underlying storage mechanisms for network service directories, distributed file systems, and object-oriented database systems. Demonstrate their ability to support the input/output performance and storage capacity needs of advanced, distributed applications.

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- (U) Prototype a common authentication, authorization, accounting, and usage metering services infrastructure based on digital signatures, public key cryptosystems, and privacy enhanced mail.
- (U) Prototype generalized software applications approaches for discovering and interacting with services in a complex internetworked environment.
- (U) Develop generalized applications building blocks and mechanisms to support application function partitioning and migration among multiple computer nodes of the internetworked environment.
- Information Infrastructure Application Demonstrations. (\$6.7M)
 - (U) Select and experimentally characterize focused National Challenge applications testbeds leveraged on high performance network testbeds and major information technologies in high performance computing.
 - (U) Prototype technologies for distributed digital libraries, incorporating techniques for scalable storage management and data repositories, persistent object bases, and multimedia objects.
 - (U) Proof of concept prototype of copyright management system, based on Privacy Enhanced Mail (PEM), which demonstrates fully electronic copyright registration, recordation, rights transfer and management.
- Networking. (\$43.2M)
 - (U) Demonstrate cross-country gigabit and networking technologies coupled with high performance computing capabilities.
 - (U) Demonstrate more advanced Internet capabilities including more diverse bitways, such as cable and wireless links, with embedded intelligence to improve ease of use.
 - (U) Demonstrate techniques for rate-adaptive quality of service negotiation in asymmetric networks.
 - (U) Demonstrate bandwidth and service reservation guarantees for networks in support of real-time and critical services.
 - (U) Demonstrate secured routing systems.

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- Defense Applications and Infrastructure. (\$32.0M)
 - (U) Develop initial prototype of advanced C3 and weapons systems using advanced embeddable and high performance computing technologies.
 - (U) Demonstrate integrated experimental capabilities employing advanced HPC technologies for Defense users.
 - (U) Prototype networked and high performance computing capabilities for education and developing human resources projects.

D. (U) **WORK PERFORMED BY:** Massachusetts Institute of Technology, Cambridge, MA; Intel Corp, Hillsboro, OR; Carnegie Mellon University, Pittsburgh, PA; Thinking Machines, Cambridge, MA; Maden Tech, Arlington, VA; University of California, Berkeley, Berkeley, CA; Cray Research, Chippewa Falls, WI; and University of Southern California, Information Sciences Institute, Los Angeles, CA.

E. (U) **RELATED ACTIVITIES:** Program Element (PE) 0602301E, Project ST-11, Intelligent Systems and Software; PE 0603739E, Project MT-04, Electronic Module Technology; and PE 0603226E, Project EE-45, Global Grid Communications.

F. (U) **OTHER APPROPRIATION FUNDS:** None.

G. (U) **INTERNATIONAL COOPERATIVE AGREEMENTS:** Not applicable.

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A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
ST-22									
Software Engineering Technology									
	21,814	37,550	40,223	19,562	19,205	18,678	20,250	Continuing	Continuing
	(*15,635)								

*As part of a consolidation Project ST-21 (SEI) was transferred to this project. Prior year funds are shown for continuity purposes.

B. (U) BRIEF DESCRIPTION OF PROJECT: Software technology is a top item on the DoD Key Technologies list because of continually increasing demands for quality software in DoD software-intensive systems, and the need for an advanced state of software engineering practice in their production. This project funds the Software Engineering Institute (SEI) and the Software Technology for Adaptable, Reliable Systems (STARS) program.

(U) The SEI is a Federally Funded Research and Development Center (FFRDC) established in 1984 to conduct programs in software engineering. The SEI is composed of world class software engineers whose efforts are directed at transitioning technology and the acceptance of modern software engineering techniques and methods, promulgating their use throughout the defense industry, and establishing standards of excellence for the software engineering profession.

(U) The STARS program is a technology development, integration and transition program to demonstrate a process driven, domain specific, reuse-based approach to software engineering that is supported by appropriate tool and environment technology. STARS is generating three key integrating elements toward a family of large-scale "software factory" products: a set of Software Engineering Environments (SEEs); a set of modern tailorable software life-cycle process building blocks; and a software asset library capability to facilitate software productivity.

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The SEEs will be composed of commercially-supported products with open interfaces to stimulate the Computer Aided Software Engineering (CASE) tools marketplace. The SEEs will reinforce use of modern process models, have seamless interfaces to asset libraries, and will be evaluated on current DoD programs. SEI and STARS efforts are aimed at enabling future DoD software intensive weapon systems to meet mission requirements quickly and affordably.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed STARS SEE initial operational capability.
- (U) Continue development of STARS process asset library.
- (U) Tailored STARS SEEs, asset libraries, and process building blocks for use on Service demonstrations.
- (U) Evaluated and extended STARS software asset library capabilities and plan for its transition to become self-supporting.
- (U) Developed prototype STARS software development plan 2000.
- (U) Developed risk management approach and course.
- (U) Initiated integration of capability Maturity Model, Software Process Assessment, and Software Capability Evaluation instruments.
- (U) Transitioned Rate Monotonic Analysis (RMA) training to commercial vendors.
- (U) Began integrating RMA and "analytic redundancy theory" to provide improved fault tolerance.
- (U) Developed courses and tools to support security incident handling on the Internet.

(U) FY 1994 Planned Program:

- (U) Participate with and support Services in STARS demonstration projects. (\$7.0M)
- (U) Refine STARS concepts, processes, methods, tools based on demonstration projects results. (\$5.5M)

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- (U) Continue development and integration efforts in process and reuse technology. (\$2.7M)
- (U) Operate and enhance ASSET capabilities. (\$3.8M)
- (U) Refine technology transition strategies; continue support for TT affiliates program; continue commercialization initiatives; and refine and extend software development plan 2000. (\$2.0M)
- (U) Produce updated Software Process Assessment and Software Capability Evaluation instruments. (\$4.5M)
- (U) Document architecture studies in Guidebook for Real-Time Air Vehicle simulators. (\$4.5M)
- (U) Develop/conduct Risk Identification Training Course. (\$4.0M)
- (U) Begin development of a "Technology Maturity Model" and "Human Resources Maturity Model". (\$3.5M)

(U) FY 1995 Planned Program:

- (U) Continue support to Services in STARS demonstration projects. (\$6.0M)
- (U) Software architectures and application code developed using STARS Technologies on demo projects in testing and evaluation. (\$5.4M)
- (U) Final STARS concepts, processes, methods, tools based on demonstration projects results. (\$4.0M)
- (U) Refine technology transition strategies, continue support for TT affiliates program; continue commercialization initiatives; and software development plan 2000 available for wide-spread use. (\$3.8M)
- (U) Operate and enhance ASSET capabilities. (\$2.0M)
- (U) Develop initial version of "Process Value Method" for determining anticipated business value of a process change. (\$2.0M)
- (U) Develop Risk Evaluation training course. (\$2.0M)
- (U) Produce guides to best model-based software engineering practice (\$6.0M); to best reengineering practice (\$5.0M); and an Open Systems Architecture Handbook. (\$4.0M)

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D. (U) WORK PERFORMED BY: The SEI is a Federally Funded Research and Development Center. The contractor is Carnegie Mellon University, Pittsburgh, PA. The STARS prime contractors are Boeing Aerospace Corporation, Kent, WA; IBM Federal Systems Company, Gaithersburg, MD; and Paramax, McLean, Va.

E. (U) RELATED ACTIVITIES:

- (U) 0602301E, Intelligent Systems and Software (ST-11).
- (U) 0601101E, Information Sciences (CCS-02).
- (U) 0603756D, Consolidated DoD Software Initiative (Ada Program).
- (U) 0604740F, Computer Resource Management Technology.

(U) The ARPA PE activities above are managed to ensure that there is no duplication of effort among programs. ARPA ensures that SEI and STARS commonalities are synergetic by supporting a joint STARS/SEI team to work on process element definitions.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete Program	Total
ST-23 Counter-Proliferation Technology	26,451	22,276	40,802	51,217	60,738	68,402	69,112	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: There are two interrelated components of this project. One addresses the problem of counter-proliferation which has been highlighted by the DoD; the other addresses a national effort for a Comprehensive Test Ban (CTB) Verification Readiness Program to enhance U.S. surveillance capabilities for monitoring worldwide nuclear explosions and a focused program to develop technologies for detecting the production, testing and storage of nuclear materials and weapons.

(U) The objective of the Counter-proliferation effort is to develop new technologies and enhance existing technology to support detection, monitoring, and interdiction of the proliferation of nuclear, chemical, biological, and advanced conventional weapons. The project will develop and provide early demonstration of advanced sensors, information processing, modeling, command and control, and response option technologies to enable the warning, capabilities assessment and tailored counter-proliferation options that are required to effectively detect, monitor and neutralize these threats. This effort is critically needed to provide decision-makers with vastly increased flexibility in dealing with potential adversaries acquiring weapons of mass destruction capabilities.

(U) Legislative and administration policy is to complete negotiations of an internationally verifiable CTB by 1996, with a demonstration of a prototype international verification system in 1995. This project provides the advanced research and development on verification technologies which will be needed to negotiate and implement this treaty. Included in this project is the

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development and testing of key elements of an International Monitoring System and advanced surveillance technologies needed for incorporation into existing operational nuclear monitoring systems. The proliferation of weapons of mass destruction and their associated delivery systems constitute the major threat to U.S. armed forces and allies in the Post-Cold War security environment. This project also addresses methods for demonstrating technologies to enhance the monitoring of the Nuclear Non-Proliferation Treaty and its renewal.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Counter-proliferation Monitoring
 - (U) Began program for advanced nuclear materials sensor systems, including: high-resolution; room-temperature radiation devices; high-efficiency xenon detectors; and scintillating fiberoptics.
 - (U) Began the development of laboratory nanoscale particle analysis techniques for improved forensic assay and interpretation of nuclear samples.
 - (U) Began development and demonstration of the components of a global proliferation monitoring system and automated effluent monitoring, including deployment of an initial prototype at a site near Iran.
 - (U) Began a development program for the detection and identification of the first test of potential proliferating countries, including the use of miniaturized electronics and optimized configurations.
- (U) Nuclear Test Monitoring
 - (U) Provided technical support to Comprehensive Test Ban (CTB) deliberations, including those on the Conference on Disarmament and began testing of a prototype international CTB seismic monitoring system.
 - (U) Developed key elements of the U.S. CTB verification readiness program.
 - (U) Began transfer of technology of advanced seismic arrays and Intelligent Monitoring System to the U.S. Atomic Energy Detection System.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

Project Number: ST-23 Date: February 1994

PE Title: Computing Systems and

Budget Activity: 2. Exploratory Development

Communications Technology

- (U) Completed Yield Estimation System and transferred to U.S. Atomic Energy Detection System.
- (U) Developed multivariate statistical analysis framework for seismic event discrimination.
- (U) Developed an advanced low-cost experimental seismic array for deployment and testing in the Mideast.
- (U) Tested a new Threshold Monitoring (TM) concept on the Russian test site at Novaya Zemlya.

(U) FY 1994 Planned Program:

- (U) Counter-proliferation Program. (\$10.4M)
 - (U) Explore technologies which leverage ARPA work in information processing and data fusion, C3I, sensor development, tracking and surveillance, and modeling.
 - (U) Develop technologies for detection of trace evidence of nuclear weapon development, including improved laboratory nanoscale particle analysis techniques.
 - (U) Develop nuclear radiation detection and imaging sensors, including high-resolution, room temperature sensors.
 - (U) Develop joint non-proliferation technology projects with scientific and engineering groups in the former Soviet Union.
 - (U) Develop components for a global proliferation monitoring system.
- (U) U.S. CTB Verification Readiness Program. (\$11.9M)
 - (U) Continue development and testing of components of a prototype surveillance system which will be required for CTB monitoring, with focus on advanced signal processing technologies at a data center.
 - (U) Implement technologies for global nuclear threshold monitoring.
 - (U) Develop and test techniques for automated knowledge acquisition in areas where the U.S. has little previous experience.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and
Communications Technology

Project Number: ST-23

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Explore technologies for automated signal processing, including machine learning and new visualization methodologies.
 - (U) Transfer seismic sensor development technologies to operational agencies.
- (U) FY 1995 Planned Program:
- (U) Counter-proliferation Program. (\$25.4M)
 - (U) Specify, define and correlate sensor, processing, C3I and response option requirements and relevant technology state-of-the-art to identify technology gaps.
 - (U) Develop a testbed concept to address counter-proliferation technology gaps which includes on-going sensor technology, information processing and fusion, C3I, simulations and response option development projects to detect and classify early acquisition development and explore policy planning aids.
 - (U) Develop technologies for the tracking and surveillance of WMD.
 - (U) Design nuclear and chemical/biological weapon modeling and monitoring systems which include: advanced sensors; information processing of open source and intelligence data to perform correlations based on nuclear and chemical weapons production vulnerability models; and output activity status and collection recommendations.
 - (U) Develop joint chemical-nuclear projects with laboratories in former Soviet Union.
 - (U) Demonstrate the operation of particle and air sampling monitoring systems as portions of an open global nuclear proliferation monitoring system.
 - (U) Demonstrate laboratory nanoscale particle analysis techniques.
 - (U) Demonstrate prototype operation of high-resolution room temperature radiation sensors.
 - (U) Begin integration of radiation monitoring devices and other sensors into internetted unattended sensors and design concepts of operation for detection and/or area denial.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and Communications Technology

Project Number: ST-23

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Develop advanced technologies for application of microelectromechanical systems for applications in monitoring roles.
- (U) U.S. CTB Verification Readiness Program. (\$15.4M)
 - (U) Develop and test technologies for applying advanced signal processing technologies to large volumes of data from diverse multisensors required for CTB monitoring.
 - (U) Develop methods of automated signal detection and characterization, especially for small seismic events.
 - (U) Develop advanced computing system architectures and data management techniques for reliable and distributed processing.
 - (U) Continue the transfer of advanced signal processing technologies into operational systems.
 - (U) Develop and incorporate methods for non-seismic technologies into overall event detection and analysis.

D. (U) WORK PERFORMED BY: Major performers include: Teledyne Geotech, Garland, TX; Science Applications International Corporation, San Diego, CA; Southern Methodist University, Dallas, TX; California Institute of Technology, Pasadena, CA; Constellation Technologies, Inc, St. Petersburg, FL; Hughes Santa Barbara Research Center, Santa Barbara, CA; and Grumman Aerospace Corp, Bethpage, NY. Major contracts for new efforts will be competed.

E. (U) RELATED ACTIVITIES: Complementary research is conducted by the National Laboratories of the Department of Energy and by the Air Force Technical Applications Center for operational applications. Close coordination of the program is carried out with the CIA Non-Proliferation Center. The counter proliferation technology effort will build on developments of the Joint DoD Advanced Technology Demonstrations for Global Surveillance and Communications and Precision Strike Thrust Areas, utilizing the technology specifically developed for the WAR BREAKER Program (PE#0603226E, Project Number EE-40). There is no unnecessary duplication of effort.

F. (U) OTHER APPROPRIATION FUNDS: None.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602301E

PE Title: Computing Systems and
Communications Technology

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Budget Activity: 2. Exploratory Development

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Agreements with Norway, the Federal Republic of Germany, China, and the Russian Federation call for joint activities in facilities within those countries. The United Nations' Conference on Disarmament, with U.S. concurrence has formally agreed on the development of an international monitoring system and large scale tests of this system and agreements have been made with a large number of countries, including Russia, China, Egypt, and Pakistan to support this effort.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
TT-03 Naval Warfare Technology	33,156	26,459	33,383	36,687	37,728	40,830	51,407	Continuing	Continuing
TT-04 Advanced Land Systems Technology	6,879	14,900	33,239	32,654	31,500	34,986	41,686	Continuing	Continuing
TT-05 Advanced Targeting Technology	14,663	*8,303	5,848	0	0	0	0	0	302,046
TT-06 Advanced Tactical Technology	19,367	26,285	**38,873	27,142	36,143	48,848	63,059	Continuing	Continuing
TT-07 Aeronautics Technology	25,250	12,705	0	0	0	0	0	0	120,330
	<u>99,315</u>	<u>88,652</u>	<u>111,343</u>	<u>96,483</u>	<u>105,371</u>	<u>124,664</u>	<u>156,152</u>		

* FY 1994 and subsequent year efforts for the WAR BREAKER portion of this project are funded in PE 0603226E, EE-40.
 ** TT-07 consolidated with TT-06 in FY 1995-99.

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Exploratory Development Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The FY 1995 Tactical Technology program funds a number of projects in the areas of Naval Warfare, Close Combat, Advanced Targeting and Advanced Tactical technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Date: February 1994

Budget Activity: 2. Exploratory Development

(U) The Naval Warfare Technology project is focusing on three areas: command, control, communications, and intelligence (C3I)/synthetic environments; ship system automation; and simulation based design. The C3I/synthetic environment program will create a multi-user maritime network to provide an accurate planning and simulation capability that will improve training, readiness, and operations planning. The Ship Systems Automation program is developing a highly integrated sensor, weapons control, and battle damage suite to reduce costly shipboard manning requirements. Finally, the Simulation Based Design program will provide the tools required to integrate cost, performance, and manufacturing considerations throughout the design process.

(U) Close Combat Technology project includes the Battlefield management, survivability enhancement programs and the Operations Other Than War (OOTW) program. The Battlefield Management and Simulation program will examine battlefield information and communications requirements through multi-level command and control simulation to improve situational awareness and contingency force responsiveness. Battlefield survivability issues will be addressed in the Integrated Survivability program, whose focus extends beyond traditional armor improvements to include signature reduction and active countermeasures. The OOTW program focuses on technological solutions to critical problems of operation such as peacekeeping and non-combatant evacuation.

(U) Finally, the Advanced Tactical Technology project is exploring the application of compact lasers, microwave radiation and advanced mathematical algorithms to enhance the performance of radars, sensors, communications, and electronic warfare systems. The technologies under development will improve infrared countermeasures, enable active infrared suppression, permit faster signal processing, improve target recognition, and create smaller, more capable microwave devices.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E Project Number: TT-03 Date: February 1994
PE Title: Tactical Technology Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Program
TT-03								
Naval Warfare Technology								
	33,156	26,459	33,383	36,687	37,728	40,830	51,407	Continuing Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The enabling technologies include: Command, Control, Communications, and Intelligence (C3I)/Synthetic Environments for Littoral Warfare; integrated ship sensor, weapons and platform technologies to demonstrate the feasibility of automation for reduced ship manning; and advanced design processes based on virtual prototyping and advanced modeling.

(U) The C3I/Synthetic Environment (SE) effort is developing advanced information technologies and architectures necessary to implement C3I systems that will facilitate Commander in Chief (CINC) and Joint Task Force Commander situational assessment, planning, and associated communications. The prototype system incorporates an embedded internetted simulation capability for collaborative planning, evaluation and rehearsal with Commander Joint Task Force (CJTF) mobile and fixed units. The prototype system converts work in synthetic environments into a complete Maritime Synthetic Theater of War (MSTOW) for improving training, readiness, operations planning and rehearsal, and war fighting. It builds upon existing ARPA-developed planning tools such as the Capability Assessment and Evaluation System (CASES), the Acoustic Warfare Integration Laboratory (AWIL), and the Maritime Anchor Desk, while identifying and incorporating other emerging C3I and information system technologies.

(U) The Ship Systems Automation (SSA) effort is developing and demonstrating advanced, highly automated sensor, weapons control, and platform (including damage control) systems for submarine and surface ship applications. Through evolving sequential demonstration of the technologies and

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Program Element: #0602702E

PE Title: Tactical Technology

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their interactions, this effort will show how an integrated system could achieve a significant reduction in crew size. Because personnel account for about 25% of ship life cycle costs, such a reduction would lead to immediate and long term cost savings for ship acquisition programs. Ship Systems Automation (SSA) technology developments include intelligent command-level decision support components, sensor integration work stations to fuse multi-source data and intelligently display the tactical situation on a tactical situation assessment system, cooperating expert systems conducting mission-context/sensor employment planning, and integrated internal condition sensor and control systems to intelligently display and control ship physical conditions on a ship's internal assessment system.

(U) The Simulation Based Design (SBD) effort is developing the technological tools necessary to advance design, development, and acquisition processes for ships and other complex mechanical systems. It is demonstrating a revolutionary design system that will permit manufacturing, cost, performance, and life cycle considerations to be coordinated and integrated throughout the entire acquisition process, from concept development to manufacture and operation. Through virtual prototyping, the system provides digital mockups using advanced visualization methods to serve as the link between the designers and the computer aided design (CAD) and physics-based engineering analysis models that form the basic structure of the process. The system provides significant cost savings through the reduction of: the number of expensive physical mockups, the total time for product design, and the amount of manufacturing rework caused by inadequate design.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated optimization of resource allocation with the Acoustic Warfare Battle Management Decision Support System for Fleet Commander.
- (U) Demonstrated Anti-Submarine Warfare (ASW) passive acoustic multi-sensor fusion using real-time data.
- (U) Prepared concept design for Ship Systems Automation (SSA) program.
- (U) Designed Simulation-Based Design (SBD) system architectures and operating system modules.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-03

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Conducted the initial SBD feasibility demonstration; demonstrated virtual environment as an input/output device to Computer-Aided Design (CAD), preliminary connectivity, seamless integration of multiple CAD representations, "ripple effect" of design modifications, simulated manufacturing sequence, and simulated life cycle activities.
- (U) Selected and initiated the ten projects of the Center of Excellence for Research in Ocean Sciences (CEROS) core development program in ocean science and maritime-related activities using a Broad Agency Announcement.

(U) FY 1994 Planned Program:

- (U) Demonstrate full fidelity acoustic synthetic ocean environment simulation capability and begin development of an electromagnetic environment. (\$2.2M)
- (U) Initiate development of an integrated situation assessment, planning, and planning assessment architecture and associated wideband communications antenna technologies for Commander in Chief (CINC) and mobile Commander Joint Task Force (CJTF) command complexes. (\$6.9M)
- (U) Develop the architecture for Ships Systems Automation (SSA) in the four major operator/associate areas of Tactical Scene, Tactical Action, Platform Readiness, and Command & Control; conduct initial laboratory demonstration of the Tactical Scene Operator/Associate area. (\$3.2M)
- (U) Conduct the final Simulation Based Design (SBD) feasibility demonstration showing real-time interaction in virtual environment, seamlessly integrating component production from design through manufacture; initiate the development of key enabling technologies. (\$9.2M)
- (U) Select work from previous CEROS efforts for follow-on and initiate new CEROS ocean science efforts. This effort funded by a Congressional addition to the FY 1994 President's Budget. (\$5.0M)

(U) FY 1995 Planned Program:

- (U) Demonstrate an initial integrated Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) architecture in a selected maritime

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Program Element: #0602702E

PE Title: Tactical Technology

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Budget Activity: 2. Exploratory Development

- theater-wide planning/planning assessment scenario at the CINC Command Complex and a linked at-sea CJTF. Conduct laboratory demonstration of advanced technology wideband satellite communications between the Commander in Chief (CINC) and mobile Commander Joint Task Force (CJTF) command complexes. (\$7.0M)
- (U) Expand synthetic environment development to include a complete electromagnetic environment to create a full spectrum Maritime Synthetic Theater of War (MSTOW). (\$2.3M)
- (U) Conduct Ship Systems Automation (SSA) demonstrations with emphasis on Tactical Scene Assessment/Presentation and Defensive Warfare Associate, interactive component technologies, and force multiplier technologies that support significantly reduced manning on warships. (\$8.4M)
- (U) Initiate Simulation Based Design (SBD) prototype development and complete detail design. (\$8.6M)
- (U) Conduct interim demonstrations of SBD enabling technologies. (\$7.1M)

D. (U) WORK PERFORMED BY: AT&T Bell Laboratories, Whippany, NJ; Charles Stark Draper Laboratories, Cambridge, MA and Arlington, VA; Science Applications International Corporation, McLean, VA; Naval Surface Warfare Center, Dahlgren, VA and Carderock, MD; Alliant TechSystems, Arlington, VA; Lockheed Missiles & Space Co., Palo Alto, CA; and General Dynamics, Electric Boat Division, Groton, CT.

E. (U) RELATED ACTIVITIES: To ensure that there is no duplication of effort, this program is coordinated with other Offices within ARPA, the Office of Naval Research, Space and Naval Warfare Systems Command, and Naval Sea Systems Command. Close coordination together with scheduled joint demonstrations ensure maximum program synergy and no duplication of efforts.

- (U) Program Element #0603226E, Project EE-45; Joint Task Force Advanced Technology Demonstration
- (U) Program Element #0603226E, Project EE-37; Synthetic Theater of War (STOW)
- (U) Program Element #0603226E, Project EE-40; WAR BREAKER
- (U) Program Element #0603226E, Project EE-21; Battle Command Initiative

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-03 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

- (U) Program Element #0602314N; Undersea Surveillance & Weapons Technology
- (U) Program Element #0602232N; Command, Control, Communications, and Intelligence (C3I) Technology

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-04 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
TT-04 Advanced Land Systems Technology	6,879	14,900	33,239	32,654	31,500	34,986	41,686		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: This project is intended to develop technologies for contingency missions and military operations other than war to make U.S. combat forces more deployable, effective, survivable, and affordable; and to create automated design software tools for making systems acquisitions cost effective and responsive. This project supports four main efforts: Operations Other Than War (OOTW); Battle Management Simulation and Technology Development; Small Low-cost Interceptor Device (SLID); and Integrated Product and Process Development Simulation. In addition, during FY 1994, a number of efforts from the Armor/Antiarmor program are being completed.

(U) The Operations Other Than War (OOTW) program (NEW START) focuses on technological solutions to critical problems of operations such as peacekeeping and non-combatant evacuation. Critical problems include effective solutions to mines, mortars, and snipers; detection and prosecution of hostile parties comingled with civilians, and effective coordination of multi-lingual units. It will achieve this goal by developing technologies which will reduce friendly force, non-combatant and hostile casualties, and equipment damage caused by military action. Because of the nature of OOTW, the technologies that fulfill military needs often also have applicability to law enforcement. It is a secondary objective of this program to pursue development of such dual-use technologies. This program supports four main efforts: advanced sensors for survivability; low or zero damage weapons; special intelligence and communications systems; and de-mining. A brief description of these efforts is given below:

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-04

Budget Activity: 2. Exploratory Development

Date: February 1994

(U) The advanced sensors for survivability will develop technologies for detection of mortars, mines, snipers, and concealed weapons. These threats continue to be the major threat in most OOTW. The advanced sensors program will develop a phased approach to providing timely detection, precise location, and neutralization of these systems.

(U) The low or zero damage weapons program leverages existing technologies and develops new technologies designed to precisely neutralize a hostile threat while reducing the risk of collateral damage or casualties to non-combatants. This may include non-lethal technologies designed to temporarily incapacitate a threat with no long-term debilitating effects, and also includes weapons and munitions which focus on "systems" kills, and on surgical kills with minimal collateral damage.

(U) The special intelligence and communications project will develop novel methods of surveillance and tracking, and will develop a system to allow communications among multi-lingual forces. The latter will begin with a limited vocabulary "brevity code" translator which will allow a fixed dictionary of vocal commands understood and translated into the language of a coalition partner. His response will then be translated back to the original language.

(U) De-mining will deal with the problem of removing the estimated 85 million emplaced land mines around the world and returning these areas to habitability. Technology development teams will work with operational teams to develop safer, faster techniques for de-mining.

(U) The Battle Management Simulation and Technology Development program addresses command and control problems of highly mobile, joint contingency forces. On-the-move units currently cannot obtain a joint common picture of the battlefield or any graphics or imagery, and have limited planning tools available. The goal of this effort is to determine commander's information needs and to develop technologies to allow collaborative planning and to improve the situation awareness and response options of highly mobile joint contingency forces commanders at all levels. This program will produce working demonstration units of an untethered portable device to allow commanders in the field to perform collaborative planning and to obtain situational

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-04

Date: February 1994

Budget Activity: 2. Exploratory Development

awareness information and multi-media data access. This device will be linked to a simulation model which will allow these capabilities to be fully exercised. The Battle Management project supports the Battle Command Initiative (BCI) in PE 0603226E, Project EE-21 by performing technology base development and supports advanced simulation in project EE-37 by providing a linkage to distributed simulation.

(U) The Small Low-cost Interceptor Device (SLID) program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. This system will detect, track, and intercept these threats at a standoff distance sufficient to render them ineffective. Applications for the SLID system include self-defense of vehicles, high value fixed sites such as command centers, aircraft hangars, radars, and perhaps aircraft.

(U) The goal of Integrated Product and Process Development (IPPD) simulation is to provide an integrated set of computerized design tools to allow concurrent assessment of design tradeoffs for land combat vehicles including combat effectiveness, reliability, maintainability, producibility, and life cycle costs. This will result in shorter design cycles and improved flexibility to respond to new requirements or technologies while assuring an affordable, producible system. This program transitions to EE-37 in FY 1995, and will support development of hybrid electric vehicle systems in EV-01.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) The Turbo-Roto-Compound engine achieved 112 brake horsepower output from monocyliner test rig and performed pre-combustion analysis/modelling.
- (U) Completed testing and evaluation of anti-helicopter mine form/fit systems.
- (U) Performed concept refinement for Land Warrior use of commercial communication devices.
- (U) Performed studies and technologies for advanced battle command systems.
- (U) Rapidly responded to urgent CENTCOM request from Somalia with technology and prototype systems.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-04

Date: February 1994

Budget Activity: 2. Exploratory Development

(U) FY 1994 Planned Program:

- (U) Conduct studies and simulation of multi-level joint battle management information needs and technical approaches for on-the-move collaborative planning and situation awareness. (\$2.2M)
- (U) Continue exploration of commercial communications leveraging opportunities and conduct brassboard test of applicability to dismounted/mounted operations. (\$4.3M)
- (U) Integrate helicopter detection and classification algorithms into the Army's wide area mine (WAM). Transition to Army. (\$2.1M)
- (U) Terminate Turbo-Roto-Compound engine and transition technology to industry. (\$1.0M)
- (U) Begin risk-reduction phase of the Small Low-cost Intercept Device (SLID) program. (\$2.1M)
- (U) Develop and demonstrate selected simulation-based design tools required to simultaneously address performance and producibility of new weapons concepts. Define concept for integrated system of design workstations. (\$2.8M)
- (U) Complete testing of armor concepts. (\$4M)

(U) FY 1995 Planned Program:

- (U) Initiate technology development programs for sensors to detect mortars, snipers, mines, and concealed weapons. (4.8M)
- (U) Perform demonstrations and initiate selected developments for low or zero damage weapons. (\$2.7M)
- (U) Develop and demonstrate initial multi-lingual translator and develop special surveillance systems. (\$2.2M)
- (U) Conduct first de-mining competition and technology development program. (\$10.0M)
- (U) Complete development of on-the-move collaborative planning and situation awareness technology and use in a simulation testbed for advanced battle management systems. Transition to Battle Command Initiative in EE-21. (\$4.9M)
- (U) Continue Phase I (risk reduction) efforts in the SLID program and perform downselection for Phase II. (\$8.6M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-04

Date: February 1994

Budget Activity: 2. Exploratory Development

(U) Program to Completion:

- (U) Demonstrate the Small Low-cost Intercept Device (SLID) program to affordably and reliably protect high value assets at standoff. Demonstrate capability to neutralize missiles and protect light vehicles, radars and mobile headquarters.
- (U) Continue technology development for operations other than war, focusing on nonlethal weapons and detection of weapons of mass destructions.

D. (U) WORK PERFORMED BY: The major performers include Hughes Aircraft, El Segundo, CA; Raytheon, Lexington, MA; Detroit Diesel Corporation, Detroit, MI; Textron Defense, Wilmington, MA; Lawrence Livermore Laboratories, Livermore, CA; University of Iowa, Iowa City, IA; Texas Instruments, Dallas, TX; TRW, Redondo Beach, CA; Allied Signal, Towson, MD; and Rockwell International, Duluth, GA.

E. (U) RELATED ACTIVITIES: N/A

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-05 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
TT-05 Advanced Targeting Technology (WAR BREAKER)									
	*14,663	**8,303	5,848	0	0	0	0	0	302,046

*The FY 1993 and prior years Damocles effort was funded in PE0603737D, Balanced Technology Initiative.

**FY 1994 and subsequent years effort for the WAR BREAKER portion of this project are funded in

PE0603226E, EE-40.

B. (U) BRIEF DESCRIPTION OF PROJECT: By integrating advanced algorithms (automatic target recognizers) and processing technologies with multiple imaging sensors, autonomous intelligent submunitions will enhance U.S. force projection by providing a flexible and accurate delivery of munitions on a wide range of targets. Damocles will demonstrate a lower cost, intelligent, and effective submunition against these targets. It will have the ability to cover a large footprint (greater than 1 kwz) once deployed from a carrier vehicle and automatically search for, detect, and recognize sparsely positioned targets, such as SCUDS, SS-21s, and their support vehicles.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated feasibility of Command/Control connectivity to support rapid sensor to shooter target data flow.
- (U) Evaluated advanced radar and electro-optic/infrared (EO/IR) system concepts for focused surveillance applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-05

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Acquired test data to assess target detectability in foliage using an ultra wideband High Frequency (HF)/Ultra High Frequency (UHF) synthetic aperture radar (SAR) system.
- (U) Continued unattended ground sensor algorithm communications development.
- (U) Fabricated Damocles hardware components; initiated integration into a test fixture.

(U) FY 1994 Planned Program:

- (U) Complete Damocles hardware and software integration into test fixture. (\$1.0M)
- (U) Perform captive carry tests to collect data and test hardware and software integration. (\$5.8M)
- (U) Perform initial free flight experiments. (\$1.5M)

(U) FY 1995 Planned Program:

- (U) Complete Damocles experiments/tests. (\$5.8M)

D. (U) WORK PERFORMED BY: Textron Defense Systems, Wilmington, MA; Sensors Science Corporation (SENSCI), Alexandria, VA.

E. (U) RELATED ACTIVITIES: None.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-06 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
TT-06 Advanced Tactical Technology	19,367	*26,285	38,873	27,142	36,143	48,848	63,059	Continuing	Continuing

*Increases in FY 1994 due to merger of ST-12 into TT-06.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project focuses on the technology and applications of compact lasers, microwave radiation sources, and mathematical algorithms for signal processing to dramatically improve the performance of radars, sensors, and systems for electronic warfare and communications. Five broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasure, laser radars and sensors; (b) compact holographic data storage for high bandwidth image processing; (c) high performance, pulsed radio frequency (RF) radiation sources for smaller and better microwave tubes; (d) fast computational algorithms for signal processing, target recognition, electro-magnetic and acoustic propagation in nonlinear medium; and (e) passive infrared signature suppression to counter the predominate air-to-air missile threats. In addition, as an enabler of electronic warfare decoy concepts, the SENGAP propulsion system will be flight tested to validate the successful ground bench tests and integration with a decoy air vehicle.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated field transportable brassboard/lasers operating at high average power in the visible and mid-infrared spectral regions.
- (U) Initiated a program for adaptive pointing and tracking of targets for countermeasures applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

PE Title: Tactical Technology

Project Number: TT-06

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Demonstrated microcathode operation at 1 GHz modulation and 5 ampere per square centimeter emission.
- (U) Designed and fabricated on-board, off-board electronic countermeasure signal processor and generator.
- (U) Began design of an electronic system to demonstrate cooperative angle jamming technique.
- (U) Began design of a 2 Watt, 44 GHz quasi optical millimeter wave power amplifier.

(U) FY 1994 Planned Program:

- (U) Compact Laser (\$5.9M): Perform technology demonstration of power laser operation at one micron; semiconductor diodes for laser pumping; and active target acquisition for infrared countermeasure and laser radars.
 - (U) Demonstrate one kilowatt average power one micrometer wavelength laser with output at 10 joule/100 Hz, 10 nanosecond pulse length.
 - (U) Demonstrate new semiconductor laser diodes operating at 808 nanometer wavelength.
 - (U) Demonstrate wavefront aberration corrections for active pointing and tracking.
 - (U) Demonstrate design concepts for high repetition rate infrared countermeasure laser.
- (U) Holographic Data Storage (\$2.5M): Demonstrate new hologram fixing and multiplexing techniques for holographic data storage system.
- (U) Pulsed RF (\$10.1M): Design and fabricate advanced RF radiation sources for radar and RF countermeasure.
 - (U) Design and fabricate electronic system to demonstrate cooperative angle jamming technique.
 - (U) Design and fabricate 44 GHz solid state, high efficiency amplifiers for space applications.
 - (U) Design microwave power tube using microcathode to operate at 10 GHz.
 - (U) Demonstrate high performance 94 GHz amplifier operation and begin prototype design.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-06 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

- (U) Design, fabricate and demonstrate ultra high resolution radar operation using electromagnetic shockline technology.
- (U) Design reconfigurable antenna.
- (U) Fast Computational Algorithms (\$7.8M): Begin to develop novel algorithms for automatic detection and recognition of difficult-to-find objects.
- (U) Develop wavelet-based multi-resolution methods and design tools for new digital filters.
- (U) Demonstrate wavelet methods for detection of transient signals in sonar systems and for multisensor fusion.
- (U) Demonstrate robust methods for direction finding and interference reduction in airborne platforms.
- (U) Develop code for fast computation of electromagnetic scattering.

(U) FY 1995 Planned Program:

- (U) Compact Laser (\$5.0M): Demonstrate breadboard systems of compact high power lasers, laser diodes and active target acquisition for infrared countermeasure and laser radars.
- (U) Demonstrate transportable breadboard one kilowatt average power one micrometer wavelength laser with output at 10 joule 100 Hz, 10 nanosecond pulse length.
- (U) Demonstrate active pointing and tracking breadboard system.
- (U) Demonstrate breadboard infrared countermeasure laser with wavelength diversity.
- (U) Holographic Data Storage (\$7.0M): Technology demonstration of page-format and high density input and readout capability.
- (U) Demonstrate spatial light modulators and charge coupled devices for one million pixel size page storage and readout for holographic data storage.
- (U) Demonstrate 100 billion bit holographic data storage.
- (U) Pulsed Radio Frequency (RF) (\$7.5M): Continue fabrication and integration of advanced RF amplifiers and power combining techniques.
- (U) Fabricate distributed amplifier using microcathode operating at 10 GHz.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E

Project Number: TT-06 Date: February 1994

PE Title: Tactical Technology

Budget Activity: 2. Exploratory Development

- (U) Fabricate prototype high performance 94 GHz power amplifier.
- (U) Demonstrate high efficiency power combining technique of solid state devices operating at 44 GHz.
- (U) Fabricate reconfigurable antenna using microtip technology.
- (U) Fast Computational Algorithms (\$12.6M): Continue development of novel algorithms for automatic target detection, materials and microelectronics processing.
- (U) Develop and test novel wavelet-based algorithms and tools for digital processor and filters.
- (U) Develop methods for multiresolution synthetic aperture radar and adaptive waveform design.
- (U) Apply wavelet design tools to tactical communications and target recognition.
- (U) Demonstrate fast multipole radar cross section code for an order-of-magnitude increase in capability.
- (U) Develop simulation tools, signal processing and modern control methods for in-situ sensing and real-time control of materials and microelectronics processing.
- (U) Develop optimal phase-shift mask design methods.
- (U) Advanced Infrared Signature Suppression (\$2.8M): Demonstrate infrared signature suppression for aircraft against ground and airborne threats.
- (U) Miniature SENGAP turbine engine (\$4.0M): Flight test miniature SENGAP engine to validate successful bench testing and integration with decoy air vehicle concept.

D. (U) WORK PERFORMED BY: Major performers include: Hughes Aircraft Company, El Segundo, CA; Science Research Laboratory, Somerville, MA; TRW, Redondo Beach, CA; Lockheed/Sanders, Nashua, NH; Varian Associates, Palo Alto, CA; Honeywell, Bloomington, MN; Northrop Corporation, Hawthorn, CA; Northrop, Pico Rivera, CA; McDonnell Douglas, St Louis, MO; and Sundstrand Power System, San Diego, CA.

E. (U) RELATED ACTIVITIES: All programs are coordinated with Services' R&D programs to promote technology transfer and avoid duplication of effort.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602702E
PE Title: Tactical Technology

Project Number: TT-06 Date: February 1994
Budget Activity: 2. Exploratory Development

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Advanced Research Projects Agency (ARPA) is also an active participant in the US-UK Information Exchange Program on laser technology and effects.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-03 Date: February 1994

PE Title: Integrated Command and Control Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: High Definition Systems (HDS)

Popular Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program

IC-03	High Definition Systems (HDS)	152,180	84,800	67,950	68,000	91,464	94,000	Continuing	Continuing
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B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Exploratory Development Budget Activity because it develops the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications that involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; display architectures and processors; compression algorithms; and high speed data transmission. These efforts will establish a domestic technical capability and demonstrate the manufacturing capability of components necessary for military systems that capture, process, store, distribute and display high resolution images.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Initiated active matrix liquid crystal display (AMLCD) Pilot Demonstration Facility.
- (U) Initiated National Center for Advanced Information Components Manufacturing (NCAICM).
- (U) Delivered 2.3 million pixel 3-light valve digital micromirror projection display.
- (U) Demonstrated 6.3 million pixel active matrix liquid crystal display (AMLCD).
- (U) Initiated U.S. Display Consortium.
- (U) Established Phosphor Technology Center of Excellence.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-03

Date: February 1994

PE Title: Integrated Command and Control Technology

Budget Activity: 2. Exploratory Development

- (U) Demonstrated high resolution 22" flat tension mask CRT.
- (U) Demonstrated stereo camera and stereo hard copy printer.
- (U) Developed new low voltage phosphors for field emission displays.
- (U) Established cost projections for color thin film electroluminescent (TFEL) pilot line.
- (U) Demonstrated 3" monochrome flat CRT.
- (U) Demonstrated proof-of-concept 3-D autostereoscopic display.
- (U) Designed large area high performance microlithography tool.
- (U) Fabricated thin film transistors and displays using rapid thermal system.
- (U) Developed large area plasma deposition processes for liquid crystal display manufacturing.

(U) FY 1994 Planned Program:

- (U) Continue development of flat panel and projection displays for aircraft cockpit, shipboard and mobile computing and communications applications. (\$19.6M)
- (U) Continue development of enabling technology critical to high projection display performance. (\$14.7M)
- (U) Develop U.S. display industry infrastructure and help foster new domestic display business by reducing business risk and dependence on foreign suppliers. (\$8.0M)
- (U) Develop improved phosphor materials and deposition processes for emissive displays (electroluminescent, field emission and plasma displays), and train people in phosphor technology. (\$7.0M)
- (U) Develop imaging systems and processes needed to realize high information throughput. (\$10.5M)
- (U) Complete active matrix liquid crystal display (AMLCD) Pilot Demonstration Facility. (\$25.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602708E

Project Number: IC-03 Date: February 1994

PE Title: Integrated Command and Control Technology

Budget Activity: 2. Exploratory Development

(U) FY 1995 Planned Program:

- (U) Continue development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. (\$30.0M)
- (U) Continue enabling material and component technologies for performance and cost goals for liquid crystal materials, polymer electroluminescent materials, light weight optics, polarizers, color filters, flat backlights, projection lamps, field emitter materials and structures, and phosphors. (\$12.0M)
- (U) Develop manufacturing equipment and processes for the affordable production of high definition displays. Flat panel display manufacturing equipment will be scaled up to handle larger substrates at higher throughputs with improved process capability. (\$14.0M)
- (U) Design and fabricate radio-based communications modules and components. (\$8.0M)
- (U) Develop displays with integrated computation and image processing. (\$4.0M)

D. (U) WORK PERFORMED BY: The major performers are: Xerox Corporation, Palo Alto, CA; Magnascreen Corporation, Pittsburgh, PA; Photon Dynamics, Inc., San Jose, CA; XMR, Inc., Santa Clara, CA; Texas Instruments, Dallas, TX; MRS Technology, Inc., Chelmsford, MA; Planar Systems, Beaverton, OR; Sarnoff Research Center, Princeton, NJ; Zenith Corporation, Chicago, IL; Silicon Video, Cupertino, CA; Micron Display, Boise, ID; and Optical Imaging Systems, Troy, MI.

E. (U) RELATED ACTIVITIES: This project is coordinated with the advanced display technology being developed by the Army Electronics Devices and Technology Laboratory and the Air Force Aircraft Cockpit Integration Directorate and Manufacturing Technology (MANTECH) Directorate at Wright Laboratory. There is no unnecessary duplication within DoD.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Date: February 1994

PE Title: Materials and Electronics Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MPT-01 Materials Processing Technology	73,573	129,104	106,824	112,058	125,220	142,065	158,108	Continuing	Continuing
MPT-02 Electronics Processing Technology	37,202	94,332	88,471	92,033	97,928	104,252	116,453	Continuing	Continuing
MPT-03 Optoelectronics/GaAs	36,877	0	0	0	0	0	0	0	74,037
MPT-04 Advanced Lithography	71,273	0	0	0	0	0	0	0	236,934
MPT-06 High Temperature Superconductivity (HTSC)	35,461	37,788	14,238	4,000	0	0	0	0	91,487
MPT-07 Military Medical/Trauma Care Technology	0	0	15,295	28,000	30,002	24,498	19,500	0	117,295
TOTAL	254,386	261,224	224,828	236,091	253,150	270,815	294,061	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Exploratory Development Budget Activity because its objective is to develop technology related to those materials and devices that make possible a wide range of new military and commercial

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Date: February 1994

Budget Activity: 2. Exploratory Development

capabilities. Many of the programs contained in this Program Element reflect the Department's initiative to support dual-use technologies.

(U) The Materials Processing project (MPT-01) concentrates on the development of novel materials, processing techniques, and fabrication strategies for production of more efficient advanced structural and electronic materials manufactured at a lower cost. It includes research on biosensors for chemical surveillance, research on composite materials, synthesis of diamond films, high temperature semiconductors, insertion of ceramics into military system components, flexible solid freeform manufacturing, and toxic waste elimination.

(U) The Electronics Processing project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, and materials for infrared devices. Areas of emphasis include high-performance analog-to-digital converters, military optical processors, novel optoelectronic devices, artificial neural network technology, low power electronics and semiconductor process design and synthesis.

(U) The High Temperature Superconductivity project (MPT-06) materials have reached a stage of development when specific applications have been identified in thin-film electronic devices and circuitry for military avionics with concomitant benefit to commercial electronics.

(U) Military Medical/Trauma Care Technology project (MPT-07) is an initiative to significantly improve battlefield trauma care. The Advanced Biomedical Technology portion focuses on the human factors of advanced technology concepts in a front-line battlefield environment through development of body-worn monitors, field-portable digital imaging equipment, and battlefield surgical simulators. The Health Care Information segment concentrates on development of physician, medic, and community information associates for utilization by both medics during combat care scenarios and physicians during patient visits.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993		FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		Total	
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
MPT-01																
Materials Processing Technology																
	73,573	129,104			106,824	112,058	125,220	142,065	158,108							Continuing Continuing

B. (U) BRIEF DESCRIPTION OF PROJECT: The major goals of this project are to develop novel materials, processing techniques, and fabrication strategies for production of advanced structural and electronic materials with improved performance and at lower manufacturing costs. A major area of concentration is the application of process modeling, sensors, and advanced control to materials manufacturing and flexible fabrication and assembly. Other predominant areas include: biosensors for chemical surveillance and digital imaging systems for battlefield trauma care; research on composites (metal matrix, polymer matrix, ceramic matrix, carbon-carbon and microlaminate) for advanced aerospace structural materials to upgrade gas turbine engine and airframe components. Additional areas of focus are synthesis of diamond films for thermal management in electronic packaging; high temperature semiconductors, such as silicon carbide for high power applications in aircraft and electric vehicles; insertion of state-of-the-art ceramics into military system components (bearings, gas turbine engine components); precision machining of high strength alloys, composites and ceramics using laser and electron beam energy sources, flexible energy delivery systems, and process diagnostic tools. Flexible solid freeform manufacturing capabilities are being developed for high performance structural materials which will fabricate functional components directly from Computer Aided Design (CAD) files and not require part-specific tooling or operator intervention. Environmental research includes DoD-related toxic waste elimination and "green" manufacturing which seeks to eliminate or minimize toxic waste produced by manufacturing of products relevant to the DoD.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated thermal management capability of high conductivity diamond films in an electronic package.
- (U) Demonstrated 3-fold increase in diamond deposition rate by chemical vapor deposition (0.3 grams/hour).
- (U) Developed alternative high throughput arrays for robotic screening of computer-designed military therapeutics (computer-screening of lead compounds).
- (U) Demonstrated increased biosensor sensitivity and dynamic range by regulation of genetically transferred cell surface receptors.
- (U) Demonstrated a 5-fold increase in mean time between failures of ceramic hybrid bearings in air cycle machines used on jet aircraft.
- (U) Initialed intelligent manufacturing program on rapid densification of low cost carbon-carbon composites.
- (U) Demonstrated, in laboratory tests, the potential for a 30% improvement in accuracy of a heat-seeking missile through the use of ceramic hybrid bearings in the infrared (IR) seeker.
- (U) Demonstrated the fabrication of fibrous monolithic ceramics which combine the low cost component fabrication characteristics of monolithic ceramics with the damage tolerant characteristics of Ceramic Matrix Composites (CMCs).
- (U) Demonstrated production of low oxygen content, polymer derived silicon carbide fibers with strengths of one gigapascal up to 3000°F.
- (U) Establish pilot scale manufacturing of aluminum matrix composite structures.

(U) FY 1994 Planned Program:

- (U) Biotechnology (\$7.9M): Utilizes biological technologies to develop sensors and imaging systems for battlefield trauma care.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Evaluate duration/magnitude of immune response to ultrasonically altered infectious organisms. Initiate development of portable digital x-ray imaging system for battlefield trauma care.
- (U) Optimize fluidics subsystem, optimize dynamic range for cell-based biosensor.
- (U) High Temperature Structural Materials (\$46.0M): Develop and demonstrate in components affordable structural materials (composites, ceramics, alloys) for jet engines, airframes, missiles and other DoD systems.
- (U) Investigate preliminary on-line sensing concepts for composite density during direct conversion of liquid hydrocarbon to pyrolytic carbon composite matrix; incorporate reaction chemistry into computational process model.
- (U) Demonstrate order of magnitude increase in materials utilization efficiency for vapor deposition of titanium matrix in the manufacture of silicon carbide reinforced titanium matrix composites using metal matrix composite model factory.
- (U) Demonstrate the upgrade potential of the MIA2 tank dual-axis head mirror assembly with silicon carbide mirrors which replace nickel-coated beryllium metal and thereby improve durability while decreasing environmental liabilities.
- (U) Initiate program on manufacturing of silicon carbide fiber reinforced titanium alloys for components in aircraft gas turbine engines.
- (U) Material and Device Manufacturing (\$19.0M): Fabricate functional prototype components directly from Computer Aided Design (CAD) files. Reduce cost of final machining and assembly of composites and other structures. Develop processing technologies for manufacturing multi-chip modules.
- (U) Demonstrate solid freeform fabrication machine capability to produce engine quality silicon nitride components with mechanical properties comparable to those manufactured by conventional methods.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Develop concepts of flexible manufacturing to actively correct machine error using adaptive materials and demonstrate in a machine.
- (U) A cross-disciplinary materials research program will be initiated which will include research on electro-optics, catalysts for hazardous and toxic substance disposal, diamond film growth, durable protective oxidation-resistant coatings for superalloys, and other topics.
- (U) Develop flexible methods for laser shaping materials that undergo plastic flow.
- (U) Identify large format manufacturing materials and critical unit processes and initiate materials and equipment development for multi-chip module (MCM) manufacturing.
- (U) Advanced Materials and Processing (\$18.9M): Reduce processing cost of advanced composites, electronic/photonics materials, and smart materials/structures. Incorporate simulation, modeling and intelligent processing of materials concepts.
 - (U) Initiate program in high temperature, high power semiconductors for aircraft and electric vehicle applications.
 - (U) Initiate program to model and simulate complex material microstructures, alloy solidification processes, and photolithographic processes.
 - (U) Develop theoretical models to predict mechanical properties of compositionally modulated multilayer structural composites.
 - (U) Develop intelligent processing production of materials for smart structures.
- (U) Batteries (\$6.3M): Improve energy density of military batteries.
 - (U) Initiate program on rapid prototyping of solid polymer electrolyte rechargeable ambient temperature batteries to provide power for a wide range of manportable military electronic equipment, in addition to laptop computers, cellular phones, and other portable electronics.
- (U) Vapor Phase Processing (\$12.5M): Develop low-cost processing of diamond films and photovoltaics for electronic applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Complete sensor and control system development for chemical vapor deposition reactor technologies; implement second-generation control systems on direct current (DC) arc reactor systems; increase diamond manufacturing throughput with increased deposition rate, area and yield.
- (U) Demonstrate feasibility for low-cost, high-rate, high materials utilization efficiency manufacturing of copper-indium-diselenide multilayer photovoltaics using cylindrical magnetron sputtering.
- (U) Environmental Science (\$13.5M)
 - (U) Develop new casting practices which reduce the emissions of foundaries in anticipation of Clean Air Act standards for benzene, formaldehyde, and hydrocarbons focusing on emissions measurements, core and mold making technology, metal melting treatments and handling, sand reclamation, and emissions control.
- (U) Coal Utilization (\$5.0M)
 - (U) Continue research for further reductions in gaseous and particulates emissions when firing coal-based fuels in industrial-scale boilers.
 - (U) Develop coal-based fuel/waste co-firing technologies.
 - (U) Identify and test coal-based technologies that are suitable for small-scale heat and/or power applications.

(U) FY 1995 Planned Program:

- (U) Biotechnology (\$1.9M): Complete program and transition to Military Medicine/Trauma Care Technology Program. (Project MPT-07 and PE 0601101E project MS-01)
 - (U) Demonstrate biosensor device gain by modulation of intrinsic cellular amplification system (second messenger system) and complete cell-based biosensor.
- (U) High Temperature Structural Materials (\$24.9M): Develop affordable composites using intelligent processing of materials concepts.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Demonstrate on-line sensing of critical product and process variables and multivariable feedback control of the rapid densification manufacturing process for carbon-carbon composites.
- (U) Demonstrate economic polymer composite manufacturing using advanced fiber placement techniques.
- (U) Develop advanced electron beam curing process suitable for on-line production of polymer matrix composites.
- (U) Scale up manufacturing capabilities to produce fiber reinforced titanium matrix composite hollow fan blades for jet engines.
- (U) Demonstrate quality and cost benefits resulting from the application of intelligent processing of materials to the manufacture of silicon carbide monofilament fibers.
- (U) Demonstrate the reduced mean time between failure (MTBF) associated with the upgrade of glass optical domes to spinel optical domes used in the Angle Rate Bombing Set (ARBS) of the AV-8B Harrier aircraft.
- (U) Material and Device Manufacturing (\$33.7M): Extend program to address hard and soft tooling, laser cutting and manufacturing capabilities for multi-chip modules.
 - (U) Develop prototype design for adaptively-controlled machine tools.
 - (U) Develop control scheme to correct machine errors.
 - (U) Characterize thermo-mechanical properties of laser shaped parts; develop real-time process controls for laser shaping.
 - (U) Develop and apply sensor technologies for on-line process control for the large-format and roll-to-roll unit manufacturing tools identified for development of multi-chip modules.
 - (U) Demonstrate performance of large format unique materials in the manufacture of multichip modules.
 - (U) Utilizing selected laser sintering and 3-D printing solid free-form fabrication, demonstrate structural ceramic and metal components with strengths comparable to what can be produced using mass manufacturing methods.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Advanced Materials and Processing (\$24.8M): Continue processing developments for affordable materials.
 - (U) Improve defect density in semiconducting silicon carbide boules to optimize electrical properties and increase yield.
 - (U) Model, simulate and characterize optical interconnects, and crystal growth of new laser and non-linear optical materials.
 - (U) Demonstrate smart materials manufacturability.
 - (U) Develop theoretical and computational methods to predict structural and electro-optic properties for semiconductor superlattices.
- (U) Vapor Phase Processing (\$10.5M): Develop intelligent processing technologies to scale-up cost-effective manufacturing of thin film photovoltaics, multilayer turbine engine coatings, and field effect emitters.
 - (U) Initiate development of vapor deposition process models for physical and chemical vapor deposition.
 - (U) Initiate development of on-line sensing to detect critical process and product parameters in the manufacture of thin film functional multilayer structures.
 - (U) Initiate development of plasma modeling and simulation tools for vapor deposition technologies.
 - (U) Demonstrate cost-effective manufacturing and pilot line scale-up of thin film photovoltaics.
- (U) Environmental Sciences (\$11.0M): Eliminate DoD toxic waste using supercritical water oxidation (SCWO). Reduce toxic waste production as by-products of DoD-related manufacturing processes ("green" manufacturing).
 - (U) Exploit SCWO technology and initiate construction of transportable SCWO system capable of processing 1000 gallons per day.
 - (U) Develop alternative manufacturing processes for minimization/elimination of toxic wastes.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics
Technology

Project Number: MPT-01

Date: February 1994

Budget Activity: 2. Exploratory Development

D. (U) WORK PERFORMED BY: Major performers are: United Technologies Research Center, East Hartford, CT; General Electric Corporation, Schenectady, NY; Sandia Laboratories, Livermore, CA; Norton Company, Northboro, MA; 3M Corporation, St. Paul, MN; Allied Signal Aerospace Company, Phoenix, AZ; Pratt & Whitney, West Palm Beach, FL; Lanxide Corporation, Newark, DE; General Dynamics, Gorton, CT; Raytheon Corporation, Tewksbury, MA; Textron Special Materials, Lowell, MA; University of Texas, Austin, TX, Massachusetts Institute of Technology, Cambridge, MA; and Aracore Corp, Sunnyvale, CA.

E. (U) RELATED ACTIVITIES: ARPA's research on Materials Processing is coordinated within DoD and with other federal agencies via the Office of Science and Technology Policy Committee on Material (COMAT) and various DoD and other topical workshops on materials and materials processing.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-02 Date: February 1994

PE Title: Material and Electronics Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MPT-02 Electronics Processing Technology	37,202	94,332	88,471	92,033	97,928	104,252	116,453		Continuing Continuing
(MPT-03) Optoelectronics/Gallium Arsenide									
									*(36,877)

*The associated FY 1993 funding and program accomplishments and plans for this project were included in Project MPT-03 and are shown here for continuity purposes.

B. (U) BRIEF DESCRIPTION OF PROJECT: This project develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high-performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and modules, artificial neural network technology, low power electronics and semiconductor process design and synthesis. Beginning in FY 1994, efforts previously included in MPT-03 are consolidated within this project. Also, efforts in ADCs and optoelectronics previously funded under Program Element 0601101E, Defense Research Sciences, have transitioned to this project starting in FY 1994. This microelectronics development project creates the technology base for advanced electronic and optoelectronic components to meet DoD needs.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Material and Electronics Technology

Project Number: MPT-02

Date: February 1994

Budget Activity: 2. Exploratory Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated Microelectronics Manufacturing Science and Technology (MMST) fabrication cycle time and yield improvements on a 1000-wafer fabrication run.
- (U) Demonstrated MMST fabrication flexibility by processing two distinct process flows.
- (U) Demonstrated MMST capability to fabricate an externally designed circuit.
- (U) Completed design of Gallium Arsenide (GaAs) heterojunction bi-polar transistor (HBT) analog-to-digital converters (ADCs) for ultra-high-speed conversion of microwave signals to digital form for advanced signal processing.
- (U) Completed fabrication line assembly for HBTs.
- (U) Initiated effort to develop models applicable to 100 gigahertz (GHz) HBTs.
- (U) Developed neural network techniques for automatic target recognition.
- (U) Demonstrated compact neural network sensing, tracking, and recognition system.
- (U) Completed development of acoustic charged transport (ACT) chip manufacturing capability.
- (U) Scaled infrared substrate growth process to produce wafers with twice the single-crystal area.
- (U) Developed process for low-cost ferroelectric non-volatile memory. (MPT-03)
- (U) Demonstrated real-time, compact synthetic aperture radar (SAR) with spotlight mode. (MPT-03)
- (U) Demonstrated steering of wide-band radar beam with optical control module. (MPT-03)
- (U) Initiated university-industry optoelectronics centers. (MPT-03)

(U) FY 1994 Planned Program:

- (U) Test first iteration GaAs HBT-based ADCs for sampling speed and dynamic range. (\$7.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-02 Date: February 1994

PE Title: Material and Electronics Technology

Budget Activity: 2. Exploratory Development

- (U) Complete design and demonstration of GaAs heterojunction bi-polar transistor (HBT)-based Analog to digital converter (ADC) support components, such as multiplexers and demultiplexers. (\$4.0M)
- (U) Initiate effort to develop a design system for circuits operating above 10 GHz. (\$2.0M)
- (U) Develop neural network nonlinear adaptive filters for signal processing applications. (\$2.0M)
- (U) Develop neural network automatic target recognition systems for future insertion into specific military platforms, including the Comanche helicopter. (\$1.7M)
- (U) Initiate development of neural network speech recognition systems and multi-modal (speech, lip-reading, gestures, eye-tracking) command systems for computer interfaces. (\$1.5M)
- (U) Develop first-generation neural network board-level electronic hardware capable of up to 10 billion connections per second. (\$2.5M)
- (U) Develop component technologies for optoelectronic neural network hardware capable of up to 100 trillion connections per second. (\$1.6M)
- (U) Demonstrate a prototype neural network-based process control system. (\$.6M)
- (U) Complete studies on the requirements and candidate hardware and software designs for an Advanced Vision System (AVIS) that will accelerate neural network and other image processing algorithms. (\$2.0M)
- (U) Demonstrate optically controlled phased arrays and fiber-optic-based bistatic radar. (\$2.7M)
- (U) Demonstration of optical pattern recognition modules. (\$2.2M)
- (U) Demonstrate acousto-optic pulse compression signal processor and jammer nulling processor. (\$2.4M)
- (U) Demonstrate optical electronic warfare channelizer and precision direction finder. (\$1.7M)
- (U) Develop integrated monolithic tunable laser arrays. (\$2.7M)
- (U) Develop packaged optoelectronic-microwave modules for microwave transmission. (\$.6M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-02 Date: February 1994

PE Title: Material and Electronics

Budget Activity: 2. Exploratory Development

Technology

- (U) Initiate efforts to develop low-cost optoelectronic module manufacturing technologies. (\$16.5M)
- (U) Develop optoelectronic packages that incorporate passive alignment techniques between fibers and component input/output (I/O). (\$3.4M)
- (U) Establish consortia for rapid automated optical alignment packaging and for accelerate development of blue lasers for insertion into laser memory disk systems. (\$8.0M)
- (U) Improve ferroelectric memory cell performance, especially imprint characteristics. (\$1.4M)
- (U) Improve 1 gigabit density dynamic rapid access memory (DRAM) memory cell reliability and performance. (\$.4M)
- (U) Demonstrate prototype giant magneto-resistance memory cell. (\$.4M)
- (U) Initiate optical and electrical characterization of III-V bulk materials for optoelectronic and infrared device applications. (\$2.5M)
- (U) Initiate fabrication and evaluation of wide bandgap II-VI blue emitters produced on III-V substrates. (\$4.0M)
- (U) Demonstrate feasibility of 1 kg InGaAs boule growth for 50mm diameter substrates. (\$3.0M)
- (U) Optimization of electronic hardware systems. (\$10.0M)
- (U) Optimization of manufacturing software aids for electronics. (\$7.5M)

(U) FY 1995 Planned Program:

- (U) Validate high speed heterojunction bi-polar transistor (HBT) technology by manufacturing components on one pilot production line. (\$2.0M)
- (U) Demonstrate the high-speed heterojunction bi-polar transistor (HBT) process via components in a system application. (\$2.5M)
- (U) Develop and demonstrate high-speed HBT technology on pilot lines. (\$15.5M)
- (U) Apply neural network nonlinear adaptive filters to specific communication demodulation, direction-finding, and other signal processing applications. (\$.9M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Material and Electronics Technology

Project Number: MPT-02

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Begin insertion of neural network automatic target recognition systems into specific military platforms, including the Comanche helicopter. (\$1.8M)
- (U) Develop prototype large-vocabulary speech recognition systems and develop data fusion techniques for exploiting multiple modes of communication. (\$2.5M)
- (U) Demonstrate electronic neural network board-level systems on specific signal processing applications. (\$2.0M)
- (U) Demonstrate speeds of 1 trillion connections per second in first generation optoelectronic neural network hardware systems. (\$2.5M)
- (U) Establish the Advanced Vision System (AVIS) architecture framework and design custom vision chips using Rapid Prototyping of Application Specific Signal Processors (RASSP) tools. (\$5.0M)
- (U) Initiate development of supporting software for AVIS (including custom compilers, languages, debuggers, linkers, case tools, and libraries.) (\$3.0M)
- (U) Demonstrate concepts of affordable optoelectronic modules. (\$11.2M)
- (U) Field demonstration of optical pattern recognition modules and optical real-time synthetic aperture radar processor. (\$1.0M)
- (U) Demonstrate advanced serial and parallel optoelectronic busses. (\$6.0M)
- (U) Initiate insertion of prototype optoelectronic modules into system applications. (\$5.0M)
- (U) Establish manufacturing infrastructure for optoelectronic modules. (\$4.6M)
- (U) First pass design of process synthesis framework architecture. (\$5.8M)
- (U) Development of the process synthesis architecture data base methodology. (\$5.3M)
- (U) Development of reliability prediction simulation. (\$.6M)
- (U) Initiate development of device, architecture and power management technology to lower power consumption of semiconductor electronics by 100 times. (\$11.2M)

D. (U) WORK PERFORMED BY: TRW, Los Angeles CA; Rockwell, Anaheim, CA; Hughes Research Laboratory, Malibu, CA; Harris, Melbourne, FL; Texas Instruments, Dallas, TX; Lincoln Lab, Lexington, MA; Hughes Aircraft Company, Malibu, CA; Honeywell, Minneapolis, MN; Worcester

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Material and Electronics
Technology

Project Number: MPT-02

Budget Activity: 2. Exploratory Development

Date: February 1994

Polytechnic Institute, Worcester, MA; University of Southern California, Los Angeles, CA; Erim, Ann Arbor, MI; and Arizona State University, Tempe, AZ.

E. (U) RELATED ACTIVITIES: The work is coordinated with Service research efforts through the Advisory Group on Electron Devices and via annual government-wide program reviews. These activities assure that no duplication of effort occurs.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06027112E

PE Title: Materials and Electronics Technology

Project Number: MPT-06

Date: February 1994

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project

Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MPT-06									
High Temperature Superconductivity (HTSC)									
35,461	37,788	14,238	4,000	0	0	0	0	0	*220,093

* Total Program reflects both MPT-06 (97,687) and PE 0602301E, project ST-16 (122,406) where program was previously funded.

B. (U) BRIEF DESCRIPTION OF PROJECT: High temperature superconducting (HTS) materials have reached a stage of development when specific applications can be identified in thin-film electronic devices and circuitry for military avionics, with concomitant benefit to commercial electronics. The ARPA program is building specific insertions for radar and electronic detection systems with extremely wide bandwidth and dynamic range, general avionics, and airframe guidance subsystems, while continuing with the development of the underlying fabrication technology for thin films, bulk wire and other forms. Particular demonstrations include a switched filterbank for the B-1B radar warning receiver, superconducting electronic packages for electronic intelligence (ELINT) and electronic warfare suites in reconnaissance aircraft, and safe and economical devices for riveting and clamping sheet metal sections for aircraft manufacturing.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated operation of multichip modules which employ HTS interconnects in digital receiver circuits.
- (U) Demonstrated integrated HTS radio frequency (RF) components in electronic warfare and communications systems.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-06

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Initiated active, digital, cryoelectronics development based on flux-trapped quantum logic, applied to high resolution analog/digital (A/D) converter or digital radio frequency memory.
- (U) FY 1994 Planned Program:
 - (U) High Temperature Superconductors/Analog and Digital Applications (\$23.5M): Address insertions for high temperature superconducting (HTS) materials in thin-film analog and digital electronic devices and circuitry. Transition the technology to applications such as computer-aided engineering (CAE) software tools for HTS circuit characterization and optimization, and integration of available cryogenic refrigerators with HTS devices.
 - (U) Continue development of optically-switched 30 element HTS filterbank to enable signal discrimination in radar warning receivers (RWR) in a dense countermeasures environment.
 - (U) Improve acoustical damping of stabilized oscillator (STALO) based upon high-Q HTS/sapphire resonant cavity, to achieve factor of 100 improvement over current radars.
 - (U) Characterize performance criteria for radar receiver to detect sea-skimming missiles at adequate ranges in sea clutter, based upon HTS reference source and preselective filterbank integrated with low-noise antenna driver and appropriate closed-cycle cryogenic cooling system.
 - (U) Undertake development of an HTS crossbar switch to provide very high connectivity and performance enhancement (X5) over current capability, for application to mainframe computers and telecommunications.
 - (U) Fabricate digital circuits such as an asynchronous transfer mode (ATM) switch for the DoD global grid network and/or the commercial information infrastructure.
 - (U) Incorporate HTS analog components in cellular telephone and personal communications networks, utilizing the high-power handling and discrimination capability of thin-film HTS tuned filterbanks, delay lines

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-06

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) and other components to provide enhanced coverage with better unit isolation.
- (U) Develop wide-bandwidth high temperature superconducting (HTS) antennas and high-efficiency HTS coupling networks for application as miniaturized radio frequency (RF) sensors and transmitters in electronic warfare scenarios.
- (U) High Temperature Superconductors/Multi-Chip Modules (MCM) (\$14.3M): Demonstrate a fully functional module utilizing approximately 50 complementary metal oxide semiconductor (CMOS) chips which will operate with 2X greater speed in a more compact form.
 - (U) Extend materials processing capabilities to develop ion etching as a planarization technique for insulating dielectric layers and develop photoresist and etching procedures to attain fully reproducible 2 micron interconnect linewidth.
 - (U) Develop technology infrastructure by extending commercial computer-aided engineering (CAE) tools for normal metal interconnects to accommodate HTS interconnects, transitioning such capability to HTS vendors and MCM manufacturers.
 - (U) Develop alternate HTS MCM architectures such as the dual-offset mesh plane process.
 - (U) Integrate closed-cycle cryofrigerator with MCM module for a complete push-button system.

(U) FY 1995 Planned Program:

- (U) High Temperature Superconductors/Analog and Digital Applications (\$14.2M): Select the most promising HTS applications to achieve the planned ramping down of the program. (1) filterbank for suppressing radio warning receivers (RWR) saturation, (2) high resolution radar receiver development, (3) crossbar switch as a component in computers, and (4) analog components applied to communication networks.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

PE Title: Materials and Electronics Technology

Project Number: MPT-06

Date: February 1994

Budget Activity: 2. Exploratory Development

- (U) Extend the switched high temperature superconducting (HTS) filterbank to be fully compatible with the radar warning receivers (RWR) requirements of several aircraft E-W suites.
- (U) Integrate the stabilized oscillator (STALO) with the low-noise antenna driver and preselective filterbank to determine if the noise floor meets performance requirements to detect sea-skimmers.
- (U) Undertake complementary metal oxide semiconductor (CMOS) optimization according to the design proven with gallium arsenide (GaAs) components in room-temperature crossbar switch and characterize performance at low temperature with HTS interconnects.
- (U) Demonstrate function of filter networks, delay lines and other components according to specifications in subscale versions of communication networks.

D. (U) WORK PERFORMED BY: Major performers include: Superconductor Technologies, Inc., Goeleta, CA; Conductus, Inc., Sunnyvale, CA; Massachusetts Institute of Technology, Cambridge, MA; N-Chip, San Jose, CA; E-Systems, Falls Church, VA; Honeywell Corporation, Minneapolis, MN; Boeing Corp., Seattle, WA; Westinghouse Corporation, Baltimore, MD; and DuPont Corporation, Wilmington, DE.

E. (U) RELATED ACTIVITIES: Research is coordinated within DoD and with other federal agencies via the Office of Science and Technology Policy (OSTP) Committee on Materials (COMAT), HTS Coordinating Committee, and numerous workshops involving industry, universities and government laboratories, ensuring that there is no unnecessary duplication of effort.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATION AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-07 Date: February 1994

PE Title: Materials & Electronics
Technology

Budget Activity: 2. Exploratory Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY-1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MPT-07 Military Medical/Trauma Care Technology	0	0	15,295	28,000	30,002	24,498	19,500	0	117,295

B. (U) BRIEF DESCRIPTION OF PROJECT: This project is a continuation and consolidation of work previously cited under program element 0601101E (MS-01, ES-01, CCS-02), 0602301E (ST-11), and 0602712E (MPT-01). The objective is to revolutionize far-forward battlefield trauma care. The project recognizes that planned downsizing of U.S. forces creates concomitant pressure to ensure force readiness, skill mix, and effective joint doctrine at a time when battlefield casualties carry both strategic importance and tactical relevance. A review of combat casualty care has shown: (1) that 90% of combat deaths occur in the zone of close combat prior to medical or surgical intervention; (2) that fratricide continues at casualty rates as high as 20%-30%; (3) that casualty location is a continuing battlefield problem; (4) that less than 5% of U.S. Army active-duty physicians have treated combat casualties; (5) that realistic peacetime combat medical/surgical training is minimal; and (6) that medical theater-of-war communications are archaic and non-functional.

(U) This project exploits ARPA's unique leadership role in the electronics and information sciences to project advanced medical and surgical care into the far-forward battlefield area to effect early, successful, clinical intervention. Work will develop light-weight personnel status monitors (PSMs) permitting remote non-invasive clinical diagnosis, casualty localization, and friend-foe identification. The PSM, which would be worn by all soldiers as part of their combat uniforms, is further augmented with low power, secure, wireless communications. The PSM would monitor the soldiers' clinical vital signs continuously, but would remain otherwise passive unless either queried by an operational commander or the soldiers' vital signs departed from

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E
PE Title: Materials & Electronics
Technology

Project Number: MPT-07 Date: February 1994
Budget Activity: 2. Exploratory Development

established clinical norms. Use of the personnel status monitor (PSM) should reduce mortality in three ways: (1) it will prevent or reduce casualties from friendly fire by increasing command awareness of precisely where soldiers are located on the battlefield; (2) it will enable combat medics to initiate triage within moments of a soldier's wounding and, because the precise location of the wounded soldier and the critical level of injury or shock is known, will allow medics and surgeons to optimize available treatment and evacuation; and (3) it will identify dead soldiers and thus obviate the need to send evacuation teams into hostile environments.

(U) The program will develop the technology base for (early) far-forward medical/surgical intervention. The goal is to preserve critical organ system function, prevent exsanguination, reverse systemic shock, and prevent hypoxia by use of automatically controlled devices to provide immediate mechanical or pharmacologic therapy. Once pharmacologic or early surgical stabilization has been achieved, the patient will be evacuated in a critical care pod (CCP). The CCP will allow long-range evacuation under controlled physiologic and closed cycle environmental conditions, and will function like a hospital intensive care unit. The CCP will have the capacity for intrasit monitoring of vital signs, will preserve stability by administering fluids, drugs, or summoning human intervention, will mechanically support vital functions, and will provide protection from natural or militarily hostile environments. It will develop enhanced, field portable, digital imaging capabilities for critical examination of wounded combatants, and facilitate real-time transmission of high resolution clinical imagery for analysis by specialists located outside the far-forward combat zone. Initial efforts will focus on the realization of field-portable battlefield digital X-ray imaging systems. This project further develops and exploits capabilities in telemedicine.

(U) This program will develop and exploit advanced simulation technology to improve the training of battlefield health care providers and to ensure skill currency. The objectives of this effort are to provide for the virtual representation of human structure and function; insure near-seamless transition from training to clinical practice; and to permit simulation of combat-casualty medical care within the framework of operational battlefield requirements. In a setting that forgives mistakes, residents and surgeons can practice surgical approaches or plan

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-07 Date: February 1994

PE Title: Materials & Electronics
Technology

Budget Activity: 2. Exploratory Development

the strategy for the next day's surgery while the simulator illustrates the consequences of their surgical judgments. The broad sweep of physical examination, clinical diagnosis, and the pharmacologic consequences of intervention can be made part of a seamless human learning experience that permits the physician to go from a "review" on the simulator to direct interaction with the patient. The broader impact of whole-body virtual simulation on undergraduate and continuing medical education programs will allow medical students to integrate traditionally separate academic disciplines and dramatically reduce the need for human cadavers and live-animal experimentation.

(U) The development of an advanced healthcare information infrastructure supports the entire trauma care technology base. Medical information must flow seamlessly and transparently on all levels of patient care. For this to occur, a platform-independent medical record system, such as the battlefield electronic patient record (BEPR), will insure immediate continuity, distribution, and accessibility of medical information from the forward battlefield to the rear echelon support in U.S. based medical centers. This information will be archived in multimedia heterogeneous databases of laboratory studies, radiologic and pathologic images, inpatient medical records, and be available over a world wide telecommunication system for real-time interactive collaboration among physicians. In addition, the infrastructure will provide a clinical associate system which is an intelligent system that assists physicians, nurses, corpsmen and paramedics in assessing and treating patients.

(U) All elements of this project have application to the civilian health care system with the promise of improving physical accessibility to care, improving quality of care, ensuring continuity of care, and reducing health care costs.

(U) This work does not duplicate any efforts of the military services or the National Institutes of Health. For a discussion of planning and coordination see section E, "Related Activities."

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0602712E

Project Number: MPT-07 Date: February 1994

PE Title: Materials & Electronics Technology

Budget Activity: 2. Exploratory Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: Not applicable.

(U) FY 1994 Planned Program: Not applicable.

(U) FY 1995 Planned Program:

- (U) Advanced Biomedical Technology. (\$5.4M) The basic research portion of this effort is found under 0601101E project MS-01.

- (U) Continued development of the personnel status monitor (PSM) primary life state sensors; executive (controller) breadboard; PSM sensor algorithm, code and system integration; medic/command data management and decision support; miniaturized personal communications for Global Positioning Satellite system (GPS) module; interface and integrate communications to controller subsystem; involves in-house and field testing.

- (U) Develop battlefield surgical simulation for lower extremities with emphasis on kinematic realism, soft tissue deformation, muscle contractility and simple bleeding (virtual environment).

- (U) Initiate exploratory studies of telepresence surgery (on experimental model) by wireless link between contingency field hospital and remote field operating room; critical care pod with integrated vital signs monitoring and closed cycle environmental control.

- (U) Health Care Information Infrastructure. (\$9.9M)

- (U) Develop software architecture for a user-oriented associate system that captures ambulatory care data directly from physicians during patient visits.

- (U) Develop associate system that provides trauma guidelines directly to medics during emergencies and combat care scenarios.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06027112E

Project Number: MPT-07 Date: February 1994

PE Title: Materials & Electronics
Technology

Budget Activity: 2. Exploratory Development

- (U) Demonstrate shared electronic, graphic based planning and collaboration tools for multiple users in a distributed health and human services associate system.

D. (U) WORK PERFORMED BY: To be determined. Broad Area Announcement (BAA) is expected to be published during the second quarter of FY 1994.

E. (U) RELATED ACTIVITIES: Work coordinated with the U.S. Army (Medical) Advanced Technology Process Action Team, tri-service Medical R/D components, tri-service Medical R/D Command Council, the Surgeons General of the tri-services, the National Library of Medicine, the National Institutes of Health, the National Science Foundation, the Uniformed Services University of the Health Sciences, the Joint Special Operations Command School of Medicine, and the U.S. Army Warfighting Simulation Center Dismounted Landwarrior (TRADOC) Testbed.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-21 Advanced Land Systems 1(8,993)	500	24,712	33,750	44,060	53,960	54,282	Continuing	Continuing	Continuing
		2(6,769)							
EE-23 Enhanced Fighter Maneuverability 8,758	0	0	0	0	0	0	0	0	103,194
EE-24 ASTOVL/COTL 4,770	25,712	20,014	1,954	0	0	0	0	0	66,409
EE-27 Advanced Space Technology Program 14,711	28,662	5,925	7,000	6,000	10,000	16,300	Continuing	Continuing	Continuing
EE-30 Smart Weapons Application Program 7,203	0	0	0	0	0	0	0	0	50,131
EE-34 Guidance Technology 13,260	10,144	10,870	18,937	18,000	17,000	6,000	0	0	107,447
EE-36 Advanced ASW Technology 10,721	17,180	15,885	16,533	16,903	22,614	23,550	Continuing	Continuing	Continuing

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
 PE Title: Experimental Evaluation of
 Major Innovative Technologies
 Date: February 1994
 Budget Activity: 3. Advanced Development

EE-37	Advanced Simulation	43,443	59,216	79,280	76,897	40,675	61,000	58,053	Continuing Continuing
EE-39	Unmanned Undersea Vehicle Systems	15,880	23,850	17,839	17,900	17,570	17,395	18,115	Continuing Continuing
EE-40	Critical Mobile Targets	34,724	117,268	132,960	148,413	152,565	135,487	140,137	Continuing Continuing
EE-41	Air Defense Initiative	3(32,018)	24,642	38,600	25,600	25,000	35,000	30,000	Continuing Continuing
EE-43	Alternative Power Sources	54,539	0	0	0	0	0	0	54,539
EE-44	Wingship	5,000	0	0	0	0	0	0	5,000
EE-45	Global Grid Communications	0	19,209	48,487	51,926	49,842	43,592	7,435	0 220,494
EE-46	Defense Simulation Internet	0	31,617	15,855	26,200	37,000	0	0	110,672
EE-CLS		73,960	202,308	198,904	222,378	233,746	223,591	231,412	Continuing Continuing
		286,969	560,308	609,331	647,488	641,361	619,639	585,284	

1Previously funded in OSD PE 0603737D
 2Previously funded in PE 0602702E
 3Previously funded in OSD PE 0603741D

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Advanced Development Budget Activity because its purpose is to demonstrate and evaluate advanced research and development concepts. Twelve projects are funded within this program element such as the Air Defense Initiative, Critical Mobile Targets, Advanced Simulation, Advanced Space Technology, and Global Grid Communications projects. A number of advanced technology demonstrations are funded within these twelve activities and several projects have dual-use applications. A discussion of the most significant projects follows.

(U) The Air Defense Initiative (ADI) is examining innovative technologies to counter the airborne threat posed by cruise missiles and manned aircraft. Technologies under evaluation include sensor upgrades, data integration and identification improvements, and radar-absorbent materials research. Advanced infrared measurement and high resolution digital imagery systems are also under development, and a simulation and modelling effort is included to test and demonstrate ADI concepts.

(U) Advanced Simulation efforts will provide a distributed, scalable seamless warfighting environment at the weapon level of detail that will ultimately provide a massive synthetic theater of war capable of supporting such requirements as readiness training, doctrine refinement, requirements analysis, battle management simulation, and contingency planning. Communications and data infrastructures, range instrumentation and computer image generation are just a few of the developmental activities funded in the Advanced Simulation program.

(U) The Critical Mobile Targets (WAR BREAKER) project is developing a comprehensive system of sensors, communication suites, and information processing systems to detect, identify, and prosecute high value, time-critical fixed and mobile targets such as theater ballistic missiles, tanks, and artillery.

(U) Building on prior success in small satellite and launch vehicle programs, the Advanced Space Technology project will continue to develop IMPACT as a multidisciplinary program aimed at leveraging advanced technologies to reduce the life-cycle costs of all military satellite

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of

Major Innovative Technologies

Date: February 1994

Budget Activity: 3. Advanced Development

communications (MILSATCOM) terminals with associated reductions in size, weight and power consumption of MILSATCOM terminals and increased performance, reliability and capabilities.

(U) The Global Grid Communication project will develop and demonstrate advanced communications technologies needed for defense and intelligence operations for the 21st century. The ultimate goal is deployment of a gigabit network that will be interoperable with commercial, optical and secure wireless networks.

(U) This program element also includes efforts in Land Warfare, advanced ASW technologies, Unmanned Undersea Vehicles, Advanced Guidance/Targeting Technologies, and Defense Simulation Internet.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of Major Innovative Technologies
Project Number: EE-21
Date: February 1994
Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Land Systems		FY 1993		FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		To		Total	
Popular Name		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
EE-21 Advanced Land Systems		0	500	24,712	33,750	44,060	53,960	54,282	Continuing	Continuing									
		*(8,993) *(6,769)																	

*Speakeasy was funded in PE 0603737D, Balanced Technology Initiatives in FY 1993 and in PE 06012702E, (TT-07) in FY 1994.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Operation Desert Storm demonstrated that current theater command, control and communications systems lack the ability to support critical interoperable, joint/combined, wide-area multi-media communications to the mobile commander. Additionally, these systems fail to provide joint real-time situational awareness, a collaborative planning capability, and assured communications. These infrastructure shortfalls are particularly acute during early entry operations when the availability of military communications assets is most limited.

(U) On-going Advanced Technology Demonstrations being conducted by the Army will provide enhancements based on existing communication systems (e.g., SINGARS) which will allow horizontal integration of Army elements and the synthesis of electronic maps showing the location of all friendly Army units. The programs in this descriptive summary will extend this capability to provide joint, wide-area, multimedia information. Specifically, this program will provide a rapidly-deployable, affordable system covering a large (~200 mile) operational area and capable of providing a joint common situation awareness picture, collaborative planning (i.e., teleconferencing by voice and with an electronic "blackboard"), and multi-media information access to on-the-move users.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-21

Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

(U) Speakeasy is a program to develop a multi-band, multi-mode programmable digital radio capable of communicating with a wide variety of existing military and civilian radios. Initially, this will allow units to communicate across the services. As Speakeasy is proliferated, it will allow increased rates of data transfer to occur. This will improve data flow within and across services and result in long-term cost savings by allowing a common tri-service replacement radio which is interoperable with existing systems in each of the services. Speakeasy will inter-operate with all elements of the Battle Command Initiative as well as with existing systems to provide enhanced connectivity, and will provide service in situations where commercial communications may be inadequate, for example, where special anti-jam or low-probability of intercept communications are needed.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: Not applicable.

(U) FY 1994 Planned Program:

- (U) Investigate advanced fire detector systems and fire suppressants for metal fires. (\$0.25M)
- (U) Investigate innovative methods and techniques for monitoring nuclear waste. (\$0.25M)

(U) FY 1995 Planned Program:

- (U) Perform detailed designs of the BCI communications system; begin integration of the communication and data management technologies. (\$8.5M)
- (U) C2T2: Conduct squad level demonstrations of leveraged advanced civilian personal communications and computation technology for dismounted soldiers and vehicles, in military operational training/test environment. Link helicopter reconnaissance and mine detection to ground units for prosecution. (\$9.2M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-21

Date: February 1994

Budget Activity: 3. Advanced Development

(U) This program comprises three projects: the Battle Command Initiative, the Commercial Communications Technology Testbed, and the multi-band, multi-mode radio (Speakeasy). These are discussed below.

(U) The Battle Command Initiative will develop and demonstrate a rapidly deployable system hosted on an airborne platform which will provide wide-area multi-media communications and data access to on-the-move users and a series of smart terminals to allow mobile commanders to use the communications system to obtain a joint common situation awareness picture, perform collaborative planning with other commanders and staff, and obtain multi-media information including graphics and imagery. To achieve affordability, the effort will leverage commercial and consumer technologies to the extent possible (e.g., emerging cellular communications and direct broadcast video). These will pass information to and from battlefield systems such as the Command Ground Station and the Battle Command Vehicle to provide the necessary data access and fusion capabilities. This effort will be performed in conjunction with a multi-level distributed simulation performed in EE-37, and will employ technologies developed in TT-04.

(U) The Commercial Communications Technology Testbed will extend the capabilities developed in the Battle Command Initiative which are intended principally for use by commanders, down to individual dismounted soldiers. In this application, the focus will be on providing local coordination and targeting information as well as a system and a process for evaluating commercial communications products for dismounted applications through a "plug and play" interface. The system will provide dismounted soldiers with a wearable suite including heads-up and wrist-mounted displays and micro-computers to provide position/location and image transfer capabilities. Because the system will have both short and long-range communications, it will be used to evaluate multi-squad coordination, soldier interactions with remote sensors and weapons, and special situations such as air/ground data transfer for rapid-response coordinated attacks on snipers, mortars, and ambush teams. This project is being performed in conjunction with the Army's Twenty-First Century Land Warrior, and is expected to provide an evaluation of applicable products and improved definition of system requirements.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Project Number: EE-21 Date: February 1994
Major Innovative Technologies Budget Activity: 3. Advanced Development

- (U) Speakeasy: Begin development of advanced system featuring full electronic reprogrammability to achieve interoperability with existing military radios. (\$7.0M)

(U) Program to Completion:

- (U) Complete BCI system development and integrate it into a joint, multi-level battle management testbed system. Demonstrate the system in a joint operational exercise.
- (U) Complete development of the Speakeasy radio.
- (U) Conduct field demonstrations of integrated soldier-worn communications with remote sensors and rapid, semi-automated, precision control and firing of major caliber weapons.

D. (U) WORK PERFORMED BY: The major performers include MITRE, Boston, MA and Washington, DC; Stanford Research Institute, Menlo Park, CA; Harris Technologies, Arlington, VA; Hazeltine, Greenlawn, NY; and Army Communications/Electronics Command, Ft. Monmouth, NJ.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Not applicable. No FY 1994 Descriptive Summary.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Phase II of the Speakeasy program is jointly funded under Air Force PE #0603789F and Army PE #0602782A.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-21 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Sep '95	Initial demonstrations of selected critical components and technologies for Battle Command Initiative.
Oct-Dec 95	Soldier testing of commercial communications system for dismounted operations and assessment of alternative missions.
Mar 96	Preliminary design review of Phase II Speakeasy system.
Sep 96	Conduct demonstrations of initial system capability for Battle Command Initiative.
Oct-Dec 96	Demonstrate novel advanced warfighting concepts using the commercial communications testbed.
Mar 97	Critical design review demonstration of Phase II Speakeasy.
Aug-Sep 97	Field exercise demonstration of Battle Command System.
Sep 97	Field demonstration of sensor-soldier-shooter rapid response system.
Mar 98	Concept demonstrations of system enhancements and novel concepts using information from Battle Command System to enhance fire control and asset management.
Oct-Dec 98	Field exercises using enhanced fire control and asset management features of the Battle Command System.
Aug 99	Demonstration and testing of Phase II Speakeasy system.
Sep 99	Demonstration of advanced warfighting concept leveraging high-bandwidth real-time communications and data management to integrated tri service teams and force packages.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-24 Date: February 1994
Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: ASTOVL/CTOL Common Affordable Lightweight Fighter		FY 1993		FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		To		Total	
Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
EE-24	ASTOVL/CTOL Common Affordable Lightweight Fighter	4,770	25,712	20,014	1,954	0	0	0	0	0	0	0	0	0	0	0	0	0	66,409

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: In response to a Department of the Navy desired operational capability, the ASTOVL/CTOL Common Affordable Lightweight Fighter project was originated by ARPA to jointly investigate the technical feasibility of designing a single engine lightweight, affordable aircraft to conduct missions currently performed by the AV-8B, F-16, and F/A-18. As envisioned, the aircraft would be of modular design, providing for an Advanced Short Takeoff, Vertical Landing (ASTOVL) variant for use by the Navy and Marine Corps, and a Conventional Takeoff and Landing (CTOL) variant for use by the Air Force. These variants would share a common engine, airframe and avionics. The ASTOVL propulsive lift system would be eliminated from the Air Force variant and replaced with additional fuel capacity. Major performance goals for the operational aircraft and demonstrator include: Weight Empty: <24,000lb; Size: <F-18C; Powerplant: (Single Engine) Derivative of the F-119 or YF-120 Advanced Tactical Fighter Engine (ATFE) augmented in the STOVL variant by a shaft or gas-driven lift fan; maneuvering and airspeed flight envelope equal to or greater than the F-18; Flyaway cost: Significantly less than the F-18C.

(U) The program consists of four phases. Phase I, which has been completed, investigated propulsive lift concepts. Phase II is validating critical technologies relevant to the three most promising propulsive lift concepts. ARPA awarded two Phase II contracts in March 1993, each investigating a different augmented lift concept. These effort are exploring the critical powered lift transition corridor using large scale model demonstrations. Full or large scale demonstrations of selected critical propulsion components are also being conducted. The degree

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Major Project Number: EE-24 Date: February 1994
Innovative Technologies Budget Activity: 3. Advanced Development

of hardware development difficulty and hardware manufacturability is being analyzed, and where practical proven, in parallel with maturation of the aircraft design. The goal of this approach is not just to show that traditional engineering and manufacturing methods can be employed to produce the proposed design, but more importantly, to encourage developing and proving innovative processes for reducing engineering and manufacturing costs. A third concept, direct lift, will be investigated beginning in February 1994. If Phase II is successful, a single propulsive lift concept will be selected and Phase III will consist of design and fabrication of a full-scale technology demonstrator aircraft. Phase IV will consist of flight testing of the demonstrator aircraft.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Began Critical Technology Validation (Phase II) of this project.
- (U) Awarded two contracts: one to investigate the Shaft Coupled Lift Fan Concept and another to investigate the Gas Coupled Lift Fan Concept.
- (U) Conducted operational aircraft concept design trade studies.
- (U) Completed conceptual and preliminary design of large scale propulsion models.

(U) FY 1994 Planned Program:

- (U) Conduct small scale wind tunnel model testing and fabricate large scale propulsion model for the Shaft Coupled Lift Fan Concept. (\$8.6M)
- (U) Conduct small scale wind tunnel model testing and fabricate large scale propulsion model for the Gas Coupled Lift Fan Concept. (\$11.1M)
- (U) Conduct direct lift concept design analysis and small scale component testing. (\$6.0M)

(U) FY 1995 Planned Program:

- (U) Conduct large scale wind tunnel tests and large scale propulsion system tests for the Shaft Coupled Lift Fan Concept. (\$9.7M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Major Innovative Technologies

Project Number: EE-24 Date: February 1994
Budget Activity: 3. Advanced Development

- (U) Conduct large scale wind tunnel tests and large scale propulsion system tests for the Gas Coupled Lift Fan Concept. (\$10.3M)

(U) Program to Completion:

- (U) If Phase II is successful, action will be taken to continue with Phases III and IV of the ASTOVL/CTOL Common Affordable Light Weight Fighter program.

D. (U) WORK PERFORMED BY: Lockheed Advanced Development Company, Palmdale, CA; McDonnell Douglas Aerospace, St. Louis, MO; NASA Ames Research Center, Moffett Field, CA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: The program has been revised to reflect the additional Congressional appropriation to investigate the direct lift concept in FY 1994.

F. (U) PROGRAM DOCUMENTATION:

- (U) Navy Desired Operational Characteristics (DOC), 1988.
- (U) Joint ARPA/Navy project established by Memorandum of Agreement (MOA) dated 16 March 1993.
- (U) Joint ARPA/NASA project established by MOA dated 4 June 1993.

G. (U) RELATED ACTIVITIES: Program Element: 0603217N (Air Systems Advanced Technology Development). This is a joint program with the Navy established by MOA. A joint program office has been established with ARPA as the lead agency.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: An MOU for United Kingdom participation in FY 1994-1996 is pending. Negotiations with the UK Ministry of Defence were completed in November 1994. Authority to conclude is pending.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Major Project Number: EE-24 Date: February 1994
Innovative Technologies Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestones</u>
Feb 94	Direct Lift Agreement to be Signed
Feb 95	Commence Large Scale Propulsion Model Testing
Jun 95	Propulsion System Component Testing Complete
Jan 96	Large Scale Propulsion Model Testing Complete
Jan 96	Decision to Proceed with Phase III
Apr 96	Proceed with Phase III (based on favorable January decision)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-27 Date: February 1994
PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
Major Innovative Technologies

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Space Technology Program		FY 1993		FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		Total	
Popular Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Program Complete
EE-27	Advanced Space Technology Program	14,711	28,662	5,925	7,000	6,000	10,000	16,300	Continuing	Continuing							

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: The Advanced Space Technology Program (ASTP) is aimed at achieving an affordability breakthrough in the development, launch and operation of satellite systems. To date, the goals have been to demonstrate low cost access to space with small launch vehicles; reduce the size, weight, power and cost of satellite components; and demonstrate first-generation lightweight satellite capabilities. This phase has formed a prerequisite technology foundation and has produced two new launch vehicles (the Pegasus Air-Launched Vehicle and the Taurus Standard Small Launch Vehicle), 10 small satellites and numerous advanced, miniaturized components. This phase of the program will conclude with the launch of Taurus, on-orbit demonstration of DARPA-SAT and completion of the remaining technology projects.

(U) IMPACT is a multidisciplinary development program aimed at leveraging advanced technologies to reduce the life-cycle costs of all military satellite communications (MILSATCOM) terminals with associated reductions in size, weight and power consumption of MILSATCOM terminals and increased performance, reliability and capabilities. The program addresses broad technology efforts that span all MILSATCOM terminal programs with technology initiatives in support of next-generation terminals.

(U) The themes and objectives of the IMPACT program will benefit all MILSATCOM terminals, as well as many commercial products. These themes include affordability (personnel cost avoidance through autonomous operation), interoperability (programmable radio architectures to enable

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PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

simultaneous multimode, multiband operations), enhanced mobility (via miniaturization) and high-performance capabilities (very high data rate communications). The program will provide support across the spectrum (UHF, SHF and EHF) and across all terminal classes (fixed-site, mobile, manpack, airborne, shipborne, etc.).

(U) The Congressionally directed Tactical Signals Intelligence (SIGINT) Satellite (TSS) (NEW START) program is oriented to the demonstration of a tactically responsive, capable SIGINT satellite that would be characterized by direct user control and access to mission data. Additional goals of this program include the reduction of satellite acquisition time and cost, simplification of ground operations, and the reduction of O&M costs.

(U) The Congressionally directed Launch Vehicle Technologies (NEW START) program is oriented towards identification and demonstration of unique and innovative launch concepts (e.g. parafoils) and launch subsystems (e.g. hybrid propellants) which would not otherwise be explored within the launch community. The goal of this effort is to demonstrate technologies which would enable significant cost reduction in acquisition and O&M to enhance vehicle reliability responsiveness assuring rapid access to space.

(U) The Congressionally directed Large Millimeter Wave Telescope (NEW START) is a potential joint United States/Mexico program to build and operate an adaptive, high precision, wide bandwidth, 50-meter aperture millimeter wave radio telescope. The sites being considered in Mexico offer low humidity and ability to view both northern and southern skies. This telescope is being designed for a 1 arcsec pointing accuracy, which, if achieved, would better the current state-of-the-art for radio telescopes.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed most satellite component technology developments.
- (U) Supported space demonstration of component technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27

Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

- (U) Transitioned Pegasus Air-Launched Vehicle to the Air Force.
- (U) Continued preparation for the launch of Taurus.
- (U) Completed the DARPASAT satellite for launch on Taurus.
- (U) Completed source selection for the IMPACT program Broad Agency Announcement.

(U) FY 1994 Planned Program:

- (U) Conduct the launch of Taurus; initiate demonstration program for DARPASAT. (\$2.4M)
- (U) Continue technology development for IMPACT. (\$2.9M)
- (U) Initiate development of the TSS program. (\$9.9M)
- (U) Initiate development of launch vehicle technologies. (\$9.8M)
- (U) Initiate the Large Millimeter Wave Telescope design study. (\$3.0M)
- (U) Build and test a miniature version of the current shortwave infrared sensor. (\$0.6M)

(U) FY 1995 Planned Program:

- (U) Continue technology developments for IMPACT; conduct technology design reviews. (\$5.9M)

(U) Program to Completion:

- (U) Continue the IMPACT program and award testbed terminal contracts

D. (U) WORK PERFORMED BY: Orbital Sciences Corporation, Fairfax, Virginia; Space Applications Corporation, Vienna, Virginia; EMS Technologies, Inc., Norcross, Georgia; Ball Aerospace Corporation, Boulder, Colorado; Honeywell, Minneapolis, Minnesota; Hughes Space and Communications, Los Angeles, California; Phillips Laboratory, Kirtland Air Force Base, New Mexico; Rome Laboratory, Rome, New York; Air Force Space and Missile Systems Center, Los Angeles, California; Western Test Range, Vandenberg Air Force Base, California; and others associated with the IMPACT program (contracts under negotiation; none awarded yet).

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-27 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: The CAMEO, the Advanced Technology Standard Satellite Bus (ATSSB) and the Advanced Satellite Technology (ASTEC) programs which were scheduled to begin in FY 1994 are cancelled. In addition, Congress appropriated additional FY 1994 funding to initiate Hyperspectral Sensor Technology, Tactical Signal Intelligence, Launch Technologies and Large Millimeter Wave Telescope programs.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: ARPA has MOAs with the Army, Navy, Air Force, BMDO (SDIO) and others for ARPA space technology projects. There is no unnecessary duplication of effort within DoD.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestone</u>
Aug 94	Complete demonstration of DARPASAT.
Nov 94	Transition the DARPASAT to user.
Dec 95	Complete IMPACT Design Reviews.
Aug 97	Award contract for IMPACT testbed terminal.
Dec 98	Complete fabrication of IMPACT hardware.
Jun 99	Complete IMPACT Testbed Terminal fabrication.
Sep 99	Complete IMPACT Testbed Terminal demonstration.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06032226E

Project Number: EE-34 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Guidance Technology

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-34									
Guidance Technology	13,260	10,144	10,870	18,937	18,000	17,000	6,000	0	107,447

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively and with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geo-locate targets accurately in the same targeting grid in which the weapon system navigates; (2) the weapon system has a precision navigation and guidance system on-board, plus weapons with effective endgame seekers; and (3) navigation and target location systems cooperate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. The advanced navigation and guidance technologies being developed in support of this goal are the Global Positioning System (GPS) Guidance package (GGP) and Common Grid.

(U) GGP is the core component of the guidance technology project. It tightly integrates a miniature GPS receiver (MGR) and an all solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a potentially low cost, precision navigation system. GGP Phase 1 addresses the technology issues involved in: (1) miniaturizing inertial grade IMUs into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics MGR.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Project Number: EE-34 Date: February 1994
Major Innovative Technologies Budget Activity: 3. Advanced Development

(U) Common Grid (New Start) will develop a set of low cost, local GPS reference broadcast stations to coordinate precision targeting with weapon delivery systems. Common Grid will augment the baseline GPS capability within a theater of operations. It enables the passing of very accurate targeting data (1 to 3 meters CEP relative location error) without the need for real time direct communications between specific sensors and specific shooters. Common grid addresses the technology issues associated with (1) developing a miniature, low power atomic clock; (2) miniaturizing the GPS receiver; and (3) appropriately modeling the impact of phenomenological variations, staleness of ephemeris data and relaxation of user location precision after leaving the grid's coverage.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Fabricated MGR and MIMU hardware components and conducted subassembly test.
- (U) Coded software modules and began debug.
- (U) Conducted bench tests of GGP subsystems.
- (U) Developed multi-function self-aligned gate (MSAG) technologies.

(U) FY 1994 Planned Program:

- (U) Complete GGP Phase 1 system integration and benchtest. (\$5.2M)
- (U) Conduct government testing of GGP Phase 1 brassboards. (\$.3M)
- (U) Initiate GGP Phase 2 contracts to further reduce GGP in size, weight, power consumption and cost. (\$.6M)
- (U) Complete MSAG Technology for military applications. (\$4.0M)

(U) FY 1995 Planned Program:

- (U) Complete Government laboratory and field evaluations of GGP brassboards. (\$.4M)
- (U) Conduct GGP Phase 2 critical component tests and preliminary design review. (\$2.5M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-34

Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

- (U) Continue GGP Phase 2. (\$5.0M)
- (U) Design Common Grid elements and demonstrate critical subsystem feasibility. (\$3.0M)

(U) Program to Completion:

- (U) Complete GGP Phase 2.
- (U) Complete and demonstrate precision targeting and weapon delivery using developed technologies in the Common Grid Architecture.

D. (U) WORK PERFORMED BY: Naval Command, Control and Ocean Surveillance Center, San Diego, CA; Army Missile Command, Huntsville, AL; Charles Stark Draper Laboratory, Boston, MA; The RAND Corporation, Washington, DC; Galaxy Scientific Corporation, Philadelphia, PA; Litton Industries, Woodlawn Hills, CA; and Rockwell International, Collins Division, Cedar Rapids, IA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY:

(U) Technical Changes: Common Grid initiative added.

(U) Schedule Changes: GGP Phase 1 brassboard delivery.

(U) Cost Changes: Costs for Common Grid added.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: The Air Force has jointly funded GGP Phase 1 from PE 0602204F, Avionics, and PE 0603311F, Ballistic Missile Technology. No other organizations are developing and integrating technologies for high-precision, tightly-coupled, advanced solid-state MIMU/MGR equipment. In addition, ARPA is developing low-cost seeker technologies and improved methods for low cost Interferometric Fiber Optic Gyroscope (IFOG) manufacturability with funds from Electronic Manufacturing Technology, PE 0603739E.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-34 Date: February 1994
PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
Major Innovative Technologies

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Sep 94	Phase 1 Brassboard Delivery
Sep 94	Government Brassboard Tests Begin
Sep 94	GGP Phase 2 Award
Jan 95	GGP Phase 2 Preliminary Design Review
Mar 95	Initiate Common Grid Design
Oct 95	GGP Phase 2 Critical Design Review
May 96	Complete Common grid Component Feasibility Demonstration; Initiate System Brassboards
May 97	Phase 2 Contractor Testing
Nov 97	Phase 2 Brassboard Delivery
Dec 98	Government Brassboard Tests Begin

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06032226E

Project Number: EE-36 Date: February 1994

PE Title: Experimental Evaluation of Major Innovative Technologies

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Anti-Submarine Warfare (ASW) Technology

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-36 ASW Technology	10,721	17,180	15,885	16,533	16,903	22,614	23,550	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The most likely environment in which Anti-Submarine Warfare (ASW) will be conducted has changed from the deep ocean to shallow water (littoral warfare). Consequently, the focus of this project has shifted from examining innovative technologies for operations in the deep ocean to those employed in acoustically complex shallow water. This project develops technologies that will significantly enhance naval and maritime capabilities in littoral warfare environments.

(U) The project focuses on two areas of development: sonar technology and ASW scene management. The sonar technology area demonstrates applications of advanced object detection, classification, and localization technologies using high performance computing (HPC). In particular, this area focuses on demonstrating automatic simultaneous target detection, localization, and tracking algorithms in distributed active and passive sensors. Efforts in this area produce a demonstration of multi-sensor fusion through automatic detection and classification algorithms for combining non-acoustic sensor data with both active and passive acoustic data; and provide a capability to display, geographically, a complete description of the maritime tactical scene. In addition, vertically directive low frequency sources of both a continuous and impulsive nature are being developed and demonstrated. The ASW Scene Management area develops model based signal processing techniques to integrate real-time information with background intelligence to provide a complete picture of the shallow water operational situation.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-36 Date: February 1994

PE Title: Experimental Evaluation of Major Innovative Technologies
Budget Activity: 3. Advanced Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed automated multi-sensor processing in a synthetic environment.
- (U) Completed automated submarine active/passive sonar demonstration.
- (U) Advanced Sonar Processing System (ASPS): Provided a single operator sonar station permitting staff reduction.
- (U) Completed Acoustic Time Series Simulator (ATSS): Extended high-fidelity design to include multiple receiver platforms.
- (U) Characterized detection, classification, and localization performance in a shallow water environment.
- (U) Continued implementation of adaptive shallow water algorithms.
- (U) Continued development of low frequency acoustic sources for employment from tactical aircraft and ships.
- (U) Completed Autonomous Target Acquisition and Relocalization System (ATARS): Implemented a real-time, fully autonomous, 24-channel, full Directional Fixing and Ranging (DIFAR) sonobuoy system for Extended Echo Ranging (EER) application (automated detection, clutter rejection, localization, tracking).
- (U) Completed design of cooperative multi-static/multi-sensor fusion algorithm.
- (U) Completed plan and studies for wideband periscope detection.

(U) FY 1994 Planned Program:

- (U) Develop environmentally adaptive shallow water processing technologies. (\$4.9M)
- (U) Continue development of an active acoustic system for shallow water environments employing receiving arrays of various configurations and locations (multistatic active acoustic system) and conduct an at-sea ASW demonstration. (\$2.3M)
- (U) Development shallow water total scene management system providing the operational commander with complete tactical, acoustic and bathymetric information. (\$1.2M)
- (U) Continue development and testing of low frequency (LF) acoustic sources. (\$4.3M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-36 Date: February 1994

PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
Major Innovative Technologies

- (U) Develop and demonstrate vibration cancellation and seaway motion imbalance control techniques for aeroderivative gas turbine engine. (\$4.5M)

(U) FY 1995 Planned Program:

- (U) Complete system design/development of sensors and arrays for shallow water environment. (\$4.7M)
- (U) Conduct follow-on, at-sea testing of a shallow water active acoustic system and ASW scene management proof-of-concept demonstration. (\$1.4M)
- (U) Demonstrate directional source technology for diesel submarine detection. (\$4.6M)
- (U) Conduct at-sea testing for new transducer array. (\$2.5M)
- (U) Complete Anti-Submarine Warfare (ASW) scene management system design. (\$2.7M)

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Areté Associates, San Diego, CA; BBN Systems and Technologies, Arlington, VA; Raytheon Company, Portsmouth, RI; SRI International, Arlington, VA; and ORINCON Corporation, San Diego, CA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Congressional action added \$4.5M to the FY 1994 budget specifically for the aeroderivative gas turbine engine and cancelled the periscope detection program.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This program has been fully coordinated with the following programs to ensure no duplication of effort:

- (U) Supporting high performance computing efforts are ongoing under Program Element 0602301E, Computing Systems and Communications Technology.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of Project Number: EE-36 Date: February 1994
Major Innovative Technologies Budget Activity: 3. Advanced Development

- (U) Navy Enhanced Advanced Technology Demonstration (EATD) (Shallow Water Technology Initiative), Program Element 0603555N.
- (U) Navy Advanced Anti-Submarine Warfare (ASW) Technology, Program Element 0603747N.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

	<u>Plan</u>	<u>Milestones</u>
Jun 94		Complete laboratory-scale testing of low frequency (LF) acoustic sources.
Aug 94		Conduct multistatic active/passive system testing demonstration in a shallow water environment.
Sep 94		Demonstrate vibration cancellation and seaway motion imbalance control techniques.
Mar 95		Complete experimental system design for shallow water environment.
Sep 95		Conduct at-sea testing of an active acoustic system for shallow water environment.
Sep 95		Conduct at-sea testing for new transducer array.
Sep 95		Conduct Anti-Submarine Warfare (ASW) scene management system proof-of-concept demonstration.
Jun 96		Complete ASW scene management system development.
Jul 96		Complete system improvements of sensors and arrays for shallow water environment.
Nov 96		Conduct final at-sea demonstration of an active acoustic system for shallow water environment.
Jun 97		Conduct ASW scene management system at-sea demonstrations.
Jul 97		Complete development and demonstration of adaptive arrays.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-37 Date: February 1994
 PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
 Major Innovative Technologies

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Simulation		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		Total	
Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
EE-37	Advanced Simulation	43,443	59,216	79,280	76,897	40,675	61,000	58,053	Continuing	Continuing			

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Advanced Distributed Simulation program develops advanced interoperable technologies to enable a distributed, seamless warfighting simulation environment at the weapon level of detail. The ultimate goal is to provide the tools and standards necessary to create, on demand, a robust synthetic theater of war capable of supporting the following functions: Joint/Service readiness training; Joint/Service Doctrine refinement and development; requirements analysis; design, prototyping and manufacturing; and contingency planning, operations, after action review, battle management simulation, and historical analysis. The focus is on the development and integration of key technologies such as environmental representation, Semi-Automated Forces, simulation scalability, communications (advanced networking) and data flow, range instrumentation, and computer image generation. As technologies mature, they will be demonstrated and tested in joint theater war exercises of increasing size, complexity and utility which includes all forms of tactical simulation on a seamless electronic battlefield.

(U) The environmental programs concentrate on the creation of the digital environments for simulation including terrain representation, weather, diurnal variations and dynamic terrain. The Semi-automated forces creates a scalable computer-generated military force that is representative and behaviorally accurate. Scalability investigates and develops technological solutions to create network interconnections capable of accommodating a wide range of simulation goals and network demands. The communications and data flow technology development concentrates research and development in areas contributing to providing the communications infrastructure

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Project Number: EE-37

Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

capable of supporting 100,000 entities interoperating with each other in perceptible real time. Battle Management simulation relates to the initiatives developing a distributed interactive simulation environment capable of situational representations facilitating evaluations of a multi-level, joint-battle management system. (New start) The range instrumentation project addresses the problem of interfacing the live vehicles to the synthetic environment. The computer image generation program (CIG) emphasizes the need for order of magnitude increase in CIG performance along with an order of magnitude decrease in cost. The Integrated Product and Process Development Simulation provides a linked, distributed toolbox of simulation tools for concurrent engineering of land vehicles. (New start)

(U) The Advanced Simulation Technology development program (Hybrid STOW) has been selected as a probationalary Advanced Concept Technology Demonstration (ACTD).

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Planned Program:

- (U) Demonstrated technical principles for development of technologies supporting networked interoperation representing 10,000 entities on the synthetic battlefield.
- (U) Continued development of rapid terrain database generation capability and commenced environmental representation research.
- (U) Completed Phase II critical mobile target technology simulation/development network testbed with six major sites.
- (U) Demonstrated initial prototype of semi-automated forces with adaptive behavior for developmental evaluation of experimental aviation systems.
- (U) Continued development of a simulation/rehearsal node integrated with a CINC-level C4I system.
- (U) Demonstrated initial point-to-point gateways required to network instrumented real systems, ranges virtual simulators/simulations and constructive simulations.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

(U) FY 1994 Planned Program:

- (U) Demonstrate expanded technologies supporting 10,000 entities on the synthetic battlefield, and the interoperation of higher-level aggregated simulation with company networks of individual platform level simulators and company/battalion-level intelligent automated forces. Produce test and field interim scalability solutions supporting the synthetic theater of war. (\$4.0M)
- (U) Demonstrate prototype rapid terrain generation system capability to produce 100K square terrain in 14 days, initiate environmental representation research. (\$3.7M)
- (U) Demonstrate working semi-automated forces that are behaviorally accurate. (\$13.2M)
- (U) Demonstrate interoperation of simulated warfighting environment with service C3I systems in large-scale simulated maneuver exercises. (\$.8M)
- (U) Demonstrate integration of virtual warfighting simulation, constructive and live instrumented ranges. (\$22.2M)
- (U) Demonstrate interactivity of high performance aviation in virtual simulation. (\$.4M)
- (U) Initiate the Congressionally directed Virtual Brigade program for the development of a training development program to determine the optimum mix of training aids, devices, simulations, simulators and field training to intensify conventional training methods for an armored brigade. (\$14.9M)

(U) FY 1995 Planned Program:

- (U) Demonstrate simulation technologies supporting 10,000 entities as individuals on the synthetic battlefield, and the interpretation of higher-level aggregated simulation with networks of individual platform level simulators coordinated with company/battalion level intelligent automated forces. Design analyze and test solutions to creating a robust network interconnection to accommodate a wide range of local and wide area simulation. (\$6.1M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37

Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

- (U) Demonstrate working model of a system capable of generating 100K square terrain in 7-14 days, demonstrate prototype environmental representation with the simulate entities. (\$8.8M)
- (U) Develop a distributed command and control software simulation architecture capable of representing the influence of one command level on the actions of the subordinate formations. Demonstrate working semi-automated force capable of accurately representing the full range of forces in a behaviorally accurate representation. (\$16.3M)
- (U) Develop a Joint Synthetic Theater of War capability supporting seamless land/sea/air warfighting simulation environment capable of representing 10,000 entities operation with a high degree of realism, fully integrated and supporting service and joint operational concept. (\$19.4M)
- (U) Demonstrate integration of the virtual warfighting simulation, constructive simulations and instrumented range for live aviation and ground forces. (\$8.0M)
- (U) Demonstrate to the Services embedded, interoperable simulation capability spanning virtual (networked simulators), constructive (aggregate-level wargames), and real systems. (\$5.0M)
- (U) Initiate production prototype of a low cost computer image generator. (\$2.4M)
- (U) Develop and demonstrate an initial capability to simulate an environment capable of situational representations facilitating evaluations of battle management concept. (\$7.7M)
- (U) Develop concurrent engineering workstation and plan demonstration with land vehicle design. (\$5.6M)

(U) Program to Completion:

- (U) Demonstrate and transition the technologies capable of providing a seamless land/sea/air warfighting simulation environment capable of representing 100,000 entities operating with a high degree of realism, fully integrated and supporting service and joint operational concepts, retaining the arbitration of battle outcomes at the entity level of detail.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-37 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

- (U) Transition to services embedded, interoperable simulation capability spanning synthetic forces, environmental representations, communications and data flow and system scaleability.
- (U) Demonstrate and transition to the services a semi-automated forces architecture that is robust, behaviorally accurate, and scalable to all echelons of command.
- (U) Demonstrate and transition a software architecture capable of representing the full range of joint operations.
- (U) Develop a robust capability to simulate an environment capable of situational representations facilitating evaluations of battle management concepts, and of evaluating utility of developments contributing to battle management concept systems.
- (U) Demonstrate concurrent engineering applications on land vehicle design, and provide quantification of improvements.
- (U) Continue concurrent engineering workstation development leading to an improved second generation systems simulation of a virtual proving ground and virtual factory.

D. (U) WORK PERFORMED BY: Loral Advanced Distributed Simulation, Cambridge, MA; Los Alamos National Laboratory, NM; MITRE Corporation, McLean, VA; University of Michigan, Ann Arbor, MI; ETA Technologies, San Diego, CA; NCCOSC, (NRad) San Diego, CA; LNK (USA Engineering Topographic Center), Ft Belvoir, VA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: FY 1995 change reflect addition of Battle Management Initiatives.

F. (U) PROGRAM DOCUMENTATION: Memorandum of Agreements will be prepared for major projects conducted in cooperation with other government agencies, such as with Ft. Knox and USAREUR. Program development plans will be prepared for each major project.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: 40603226E

Project Number: EE-37

Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

G. (U) RELATED ACTIVITIES: Related work in technology development is closely coordinated with the Defense Modeling and Simulation Office to ensure that unnecessary duplication does not occur; Close Combat Tactical Training, STRICOM; Tactical Combat Training System (TCTS), PMA205.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestones</u>
Mar 94	Demonstrate communications and data flow technologies supporting 10,000 weapon platforms as individual objects on the synthetic battlefield.
Jul 94	Demonstrate real to virtual connectivity on instrumented ranges.
Sep 94	Demonstrate improved intelligent automated forces.
Nov 94	Demonstrate in a joint theater of war a seamless land/sea/air warfighting simulation environment representing operation with a high degree of realism, fully integrated and supporting service and joint operational concept.
Aug 95	Demonstrate to the Services embedded, interoperable simulation capability spanning virtual (networked simulators), constructive (aggregate-level wargames), and real systems.
Sep 95	Demonstrate Rapid terrain generation capability.
Sep 95	Demonstrate distributed multi-level joint command/control systems functionality
Sep 95	Demonstrate working concurrent engineering toolbox for vehicle design.
Mar 96	Demonstrate engineering feasibility of low cost computer image generation technology.
Sep 96	Provide production prototype low cost computer image generator.
Sep 96	Provide results of concurrent engineering application for land vehicle.
Sep 96	Demonstrate integration of the virtual warfighting simulation, constructive simulations and instrumented range for live aviation and ground forces.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06032226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-39

Date: February 1994

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Unmanned Undersea Vehicle Systems

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-39									
UUV/Mine Countermeasures (MCM)	15,880	23,883	17,839	17,900	17,570	17,395	18,115		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The increasing stockpile of underwater mines and submarines throughout the world present a threat in both littoral warfare and strategic warfare situations. The objective of the Unmanned Undersea Vehicles (UUV) Project is to develop and demonstrate fully autonomous, maritime UUV systems to counter this threat. In mine countermeasures (MCM), the Autonomous Minehunting and Mapping (AMM) System is expanding the technical base established by the ARPA Mine Search System to autonomously locate and classify mines with sufficient precision for detailed minefield mapping and subsequent reacquisition by a neutralization system. This capability will also be applicable for commercial undersea environmental survey and sampling. Advanced minehunting technologies, including sonars, and small robotic vehicles for mine countermeasures in the surf zone, are under development.

(U) In deployable surveillance systems (DSS) technologies, a multi-sensor buoy system containing acoustic and non-acoustic sensors with an in-situ signal processing capability is being developed. An acoustic communications network that will intelligently link the sensors to a manned or unmanned platform is under parallel development. These two systems are being integrated into an Automated Surveillance Network (ASN) for covert deployment on UUVs and other platforms.

(U) UUV enabling technologies being addressed include underwater acoustic and electromagnetic communications, atomic interferometers for precision navigation, and a high energy density fuel cell power system to provide the range and endurance required for longer UUV missions.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E Project Number: EE-39 Date: February 1994
PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
Major Innovative Technologies

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed Mine Search System (MSS) Program and transitioned to Navy.
- (U) Developed automated mapping process.
- (U) Completed studies of technology for autonomous vehicle operations in surf zone.
- (U) Fabricated multi-sensor fusion testbed and developed fusion algorithms.
- (U) Developed initial acoustic communications network capability.
- (U) Developed proton exchange membrane fuel cell power plant and prepared for testing: tested aluminum-oxygen semi-cell power plant system components and stacks.
- (U) Demonstrated high data rate (30 Kbps) acoustic communications.
- (U) Investigated potential for underwater magnetic communications.

(U) FY 1994 Planned Program:

- (U) Refurbish ARPA Unmanned Undersea Vehicle (UUV); conduct technical analyses. (\$2.4M)
- (U) Complete design for Autonomous Minehunting and Mapping (AMM) System. (\$4.5M)
- (U) Continue development of Automated Surveillance Network (ASN); conduct at-sea multi-sensor data collection and validate software design; test multi-node acoustic communication network at sea. (\$1.8M)
- (U) Conduct at-sea test with testbed magnetic communication system. (\$0.2M)
- (U) Complete testing of proton exchange membrane fuel cell power plant; complete detailed design of aluminum-oxygen power plant and start construction. (\$3.2M)
- (U) Continue development of atomic interferometer inertial sensor. (\$0.2M)
- (U) Investigate technologies for maritime counterproliferation and operations other than war. (\$0.2M)
- (U) Development molten carbonate fuel cells and 200kW phosphoric acid fuel cell system. Investigate technologies for proton exchange membrane and solid oxide fuel cells. These efforts funded by a Congressional addition to the FY 1994 President's Budget. (\$11.4M)

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Program Element: #0603226E

Date: February 1994

Project Number: EE-39

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

(U) FY 1995 Planned Program:

- (U) Configure Unmanned Undersea Vehicle (UUV) for at-sea testing; conduct modeling/simulation analysis. (\$2.9M)
- (U) Continue autonomous mine countermeasures technology development; test Autonomous Minehunting and Mapping (AMM) at-sea; test small robotic underwater vehicles and modes of locomotion. (\$7.9M)
- (U) Develop synthetic aperture sonar algorithms and models to increase minehunting area search rate and detection/classification ranges. (\$0.6M)
- (U) Demonstrate aluminum-oxygen fuel cell on land and at-sea in a UUV. (\$3.1M)
- (U) Continue Automated Surveillance Network (ASN) development and acoustic communications research; test functional multi-sensor prototype system; continue testing acoustic network. (\$2.7M)
- (U) Conduct at-sea test of prototype magnetic communication system. (\$0.3M)
- (U) Test brassboard atomic interferometer inertial sensor. (\$0.3M)

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Charles Stark Draper Laboratory, Cambridge, MA; Applied Research Laboratory, University of Texas, Austin TX; Loral Defense Systems, Akron, OH; Lockheed Missiles and Space Systems, Sunnyvale, CA; and Woods Hole Oceanographic Institution, Woods Hole, MA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Cancelled planning for development of a multi-sensor array since Navy is conducting a similar program. The aluminum-oxygen power plant design, development and test have been delayed because of component test failures, all of which have been corrected. Budget constraints have delay testing of the atomic interferometer sensor and integration of the multi-sensor buoy prototype system with the acoustic communications network. The AMM program was restructured and initial at-sea testing was delayed from FY 1994 to FY 1995.

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Program Element: #0603226E Project Number: EE-39 Date: February 1994
PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
Major Innovative Technologies

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: The Navy has established an Unmanned Undersea Vehicles (UUV) Program Management Office (PMO403) to transition these projects to the Navy. Program Element 0604559N.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Mar 94	Complete Proton Exchange Membrane (PEM) fuel cell power plant demonstration.
Sep 94	Demonstrate acoustic communications network.
Mar 95	Complete Phase I of Magnetic Communications Program.
Mar 95	Complete aluminum-oxygen fuel cell power plant demonstration.
Apr 95	Begin at-sea testing of autonomous minefield mapping system.
Jun 95	Begin at-sea testing of integrated UUV fuel cell power system.
Sep 95	Demonstrate small prototype legged robotic vehicle in surf environment.
Mar 96	Demonstrate design of prototype atomic interferometer sensor.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #06033226E Project Number: EE-40 Date: February 1994
 PE Title: Experimental Evaluation of Budget Activity: 3. Advanced Development
 Major Innovative Technologies

A. (U) RESOURCES: (\$ in Thousands)

Project Title: Critical Mobile Targets (WAR BREAKER)									
Popular	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
EE-40	Critical Mobile Targets (WAR BREAKER)	34,724	117,268	132,960	148,413	152,565	135,487	140,137	Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Prosecution of time-critical fixed and mobile targets has long been a concern of the Services as evidenced by past efforts in the areas of Strategic Relocatable Targets and Smart Weapons. Our experience in Desert Storm has dramatically demonstrated our current inability to prosecute these targets, particularly Tactical Ballistic Missile (TBM) launchers. ARPA's WAR BREAKER program will develop advanced technology and systems to enable the detection, identification and prosecution of a wide range of high value, time-critical fixed and mobile targets including TBM launchers, mobile command posts Mobile Air Defense Units, tanks and artillery. This project serves as the framework for maturing and integrating advanced technologies as well as developing and demonstrating systems concepts supporting the prosecution of these targets. Key areas include advanced surveillance, target acquisition, advanced automatic target detection and recognition, automated intelligence correlation, battlefield management, information distribution, terrain data generation technologies, advanced high throughput sensor processing, multi-sensor fusion, data fusion, image understanding, text understanding and sensor component technologies.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Continued development of advanced automatic target detection/recognition (ATD/R) algorithms for specific application to advanced synthetic aperture radar (SAR) and moving target indicator (MTI) radar for both wide area and focused surveillance.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies
Budget Activity: 3. Advanced Development

- (U) Continued concept designs of integrated surveillance system employing advanced MTI/SAR radar and multispectral EO/IR sensor.
- (U) Continued foliage penetration (FOPEN) radar technology development.
- (U) Completed system and subsystem hardware fabrication for the Multi-Sensor Target Recognition System (MUSTRS) Program.
- (U) Continued WAR BREAKER baseline concept development.
- (U) Continued WAR BREAKER systems studies incorporating initial distributed simulation system capability.
- (U) Continued development of 3-D Interferometric Radar (IFSAR) technology development.
- (U) Initiated Gamma-Gamma resonance imaging development.
- (U) Achieved terrain delimitation goal of providing reduced target search volumes with rapid turnaround.

(U) FY 1994 Planned Program:

- (U) Continue ATD/R technology development and assessment of potential target discriminants for prosecution of deep hide targets and initiate advanced MTI/SAR ATD/R algorithm tests. (\$7.2M)
- (U) Conduct MUSTRS captive flight tests. (\$9.2M)
- (U) Begin development of low cost radar (LoCoR) technology. (\$10.6M)
- (U) Analyze and assess the performance of algorithms in detecting man-made targets in foliage from imaging radar and ultra-wideband (UWB) SAR data. (\$6.5M)
- (U) Initiate Internettted Unattended Ground Sensor (IUGS) technologies development. (\$6.0M)
- (U) Complete multi-spectral EO/IR and low-cost fuel plane array technologies. (\$5.1M)
- (U) Complete baseline development of WAR BREAKER distributed simulation system. (\$20.9M)
- (U) Apply advanced processing/processors to NTM exploitation (TOPSIGHT). (\$4.4M)
- (U) Continue development of components/systems which extract, correlate, fuse, and display intelligence information to determine changes in force status, order of battle, and operational doctrine of time critical targets. (\$13.5M)

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Program Element: #0603226E

Project Number: EE-40 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

- (U) Initiate development of dynamic intelligence processor and tracking functions for the Local Attack Controller (LAC). (\$7.5M)
- (U) Demonstrate technology to rapidly fuse and distribute historical intelligence database information. (\$8.4M)
- (U) Conduct initial tests of 3-D digital terrain elevation (DTE) and provide IFSAR mapping and terrain analysis data to the state of California. (\$11.5M)
- (U) Initiate algorithm development for multi-spectral and IFSAR processing for feature extraction and elevation data fusion and for real-time modification of theater terrain data. (\$1.6M)
- (U) Continue Gamma-Gamma resonance imaging development. (\$4.9M)

(U) FY 1995 Planned Program:

- (U) Complete final development of WAR BREAKER distributed simulation system. Exercise distributed simulation and systems engineering tools in support of WAR BREAKER system concept. (\$18.0M)
- (U) Continue development, test and integration of intelligence correlation components/systems to include force status assessment demonstration and test and integration of two single intelligence correlators with the multiple intelligence correlator. (\$17.2M)
- (U) Continue development, test and integration of LAC components/systems to include a dynamic intelligence processor demonstration and a demonstration of Army-focused battle management technology. (\$10.7M)
- (U) Continue development, test and integration of Multiple Access Intelligence and Nonimaging (MAINS) to include initiation of database linking capability and a concept demonstration of the mission nominator. (\$9.4M)
- (U) Continue development, test and integration of the rapid terrain and feature generator (TFG) system to include extraction, processing and registration of elevation from IFSAR and other sources and vegetation from multi-spectral imagery. (\$6.0M)
- (U) Continue to apply advanced processing/processors to NTM exploitation (TOPSIGHT). (\$11.7M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

- (U) Continue development data analysis and evaluation of automatic target detection and recognition ATD/R algorithms. (\$8.4M).
- (U) Complete critical component design development and test of the low cost radar (LoCoR) and begin fabrication of a brassboard system. (\$23.2M)
- (U) Complete test and evaluation of Multi-Sensor Target Recognition System (MUSTRS) Technology. (\$4.7M)
- (U) Complete aircraft modification and surveillance systems installation in the P-3 testbed. (\$3.3M)
- (U) Complete software development and integration of the Imagery Exploitation System. Conduct demonstration, test, and evaluation of the automatic processing of three sensors to detect and classify units. (\$2.4M)
- (U) Continue evaluation of enabling technologies for internettted unattended ground sensors (IUGS) brassboards. (\$9.9M)
- (U) Continue data analysis and assessment of the performance of advanced algorithms for detection targets in foliage from high resolution HF/UHF ultra-wideband SAR data. (\$3.5M)
- (U) Continue technologies to provide rapid digital terrain elevation data using IFSAR. (\$4.6M)
- (U) Program to Completion:
 - (U) Demonstrate advanced ATD/R algorithms for MTI/SAR radars.
 - (U) Complete fabrication and test the advanced, low-medium altitude target acquisition/prosecution system.
 - (U) Demonstrate improved unattended ground sensors (IUGS) and the potential for an internettted UGS system.
 - (U) Complete Ultra-wideband foliage penetration radar development.
 - (U) Demonstrate the capability to correlate all-source intelligence for detection, tracking, targeting, and destruction of time critical targets.
 - (U) Demonstrate integrated intelligence correlation and battle management to facilitate local attack control.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-40 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

- (U) Demonstrate technology to build and distribute over a wide area network, terrain and feature and intelligence and object data for a 1 million square KM theater.
- (U) Demonstrate technology for LoCoR.

D. (U) WORK PERFORMED BY: General Dynamics, Convair Division, San Diego CA; Martin Marietta, Orlando, FL; ERIM, Ann Arbor, MI; Lincoln Laboratory, Lexington, MA; BDM International, McLean, VA; SAIC International, Arlington, VA; Boeing Corp., Seattle, WA; Toyon Research Corporation, Goleta, CA; Naval Command, Control and Ocean Surveillance Center, (RDT&E Division), San Diego, CA; US Army Missile Command, Redstone Arsenal, AL; Rockwell International, Anaheim, CA; SRI International, Menlo Park, CA; Loral Systems, Phoenix, AZ; Sandia National Laboratory, Santa Fe, NM; Lockheed Missile Systems, Austin, TX; Atlantic Aerospace, Greenbelt, MD; Grumman Aerospace Corporation, Melbourne, FL; Logicon, San Pedro, CA; Booz, Allen, and Hamilton, McLean, VA; Pacific Sierra Research, Santa Monica, CA; Science Research Laboratory, Inc., Somerville, MA; Grumman Aerospace Corporation, Bethpage, NY; Science Application International Corporation, Santa Clara, CA; and others to be determined.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: By Congressional direction, the WAR BREAKER portion of TT-05, PE0602702E, has been merged into this project in FY 1994 and subsequent years.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This project directly relates to precision strike efforts ongoing within the services and has been fully coordinated with Army, Navy and Air Force plans to insure non-duplication and compatibility.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Date: February 1994

Project Number: EE-40

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Mar '94	Complete MUSTRS flight experiment (Helicopter).
Jan '95	Complete MUSTRS flight test (Aircraft).
Feb '95	Complete WAR BREAKER distributed simulation.
Nov '95	Demonstrate automapping capability using IFSAR.
Nov '95	Initial demonstration of automatic cue development from contextual analysis of MTI radar data.
Nov '97	Demonstrate technology to build and distribute over a wide area network, terrain and feature and intelligence and object data for a 1 million square KM theater.
Nov '97	Demonstrate integrated intelligence correlation and battle management to facilitate local attack control.
May '98	Conduct integrated wide area/focused surveillance system demonstration.
Sep '98	Demonstrate multi-spectral and IFSAR processing feature extraction and elevation data fusion and real-time modification of theater terrain data.
Nov '98	Demonstrate capability to correlate all-source intelligence to detection, tracking, targeting, and destruction of time critical targets.
Jun '99	Conduct fully integrated WAR BREAKER demonstration.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41 Date: February 1994

PE Title: Experimental Evaluation of
Major Innovative Technologies

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Air Defense Initiative (ADI)

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-41									
Air Defense Initiative									
*(32,018)	24,642	38,600	25,600	25,000	35,000	30,000	Continuing	Continuing	

*Formerly funded in ADI PE 0603741D

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: Air Defense Initiative programs form a critical part of the Advanced Research Project Agency's program to ensure defense against cruise missiles and manned aircraft. The programs also complement systems being pursued by other program offices to counter theater ballistic missile threats. The rapid evolution and spread of cruise missile systems and technologies require new approaches and technologies to ensure effective and efficient countering of future airbreathing threats to troops in regional theaters.

(U) The Mountaintop Program determines the limits of conventional sensors to combat stealthy targets and tests adaptive signal processing techniques for advanced airborne radars. It employs an existing Navy radar at an elevated ground-based location as a efficient surrogate for an airborne platform. The geographic location provides a real-world clutter and jamming environment. The program develops a phenomenology and propagation data base, develops advanced adaptive processing hardware and algorithms, and supports integrated tests.

(U) HAVE DUNGEON enhances the capability to provide data integration and identification techniques for aerospace defense. Advanced hardware and software are developed to exploit data provided by intelligence sensors and collateral surveillance systems to provide near-real-time warning, attack assessment, and track history for the engagement of hostile targets.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of

Major Innovative Technologies

Project Number: EE-41 Date: February 1994
Budget Activity: 3. Advanced Development

(U) The Simulation and Modeling Program investigates and demonstrates new air defense technologies and concepts, and their integration into theater force structure. It emphasizes and illustrates concepts to counter the cruise missile and other airbreathing threats, and allows warfighters to test and demonstrate technology concepts. The program interacts with the existing Air Force Theater Air Command and Control Simulator Facility and the Navy Weapons and Tactics Analyses Center for man-in-the-loop simulation exercises. Extension of the initial simulation environment will be with ARPA's WAR BREAKER Defense Distributed Simulation System.

(U) The Special Materials Analysis program is investigating a new class of absorption materials developed from coated microballoons to determine their effectiveness and utility for a broad spectrum of applications.

(U) The Airborne Infrared Measurement System (AIRMS) program will provide improved scientific understanding of the fundamental limits of infrared technologies and will develop analytical tools, models and design methodologies, and associated signal processing algorithms and architectures. The program employs the existing AIRMS testbed airborne infrared imaging sensor and aircraft to collect high resolution digital imagery of airborne vehicles, background clutter, clouds, and other phenomenology.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Mountaintop Program collected bi-static clutter data at White Sands Missile Range. This data will allow development of algorithms and hardware mitigating the effects of terrain enhanced jamming of airborne early warning platforms.
- (U) HAVE DUNGEON performed a counter cruise missile experiment integrating Navy acoustic data with NORAD air sensor data, and then delivered a prototype system for auto target recognition to 480th AIG at Langley AFB, VA.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

- (U) The Simulation and Modeling Program determined requirements, completed the development plan, and completed the initial compatibility and linkage with the Air Force Simulation Facility.
- (U) The Airship Program continued the YEZ-2A design.
- (U) The HAVE YAK program began brassboard design for a low risk, near term approach for sensing to counter cruise missiles. HAVE YAK transitions to Air Force in FY94.
- (U) The Special Materials Analysis program continued the investigation of a new class of absorption materials for increased system survivability and a significant reduction in cost.

(U) FY 1994 Planned Program:

- (U) The Mountaintop program will collect a multi-channel radar data base at White Sands Missile Range. This data base will be the first of its type and will allow the user community to develop and evaluate Space-Time Adaptive Processing (STAP) algorithms for airborne applications. (\$12.3M)
- (U) HAVE DUNGEON's Proof-of-Concept Aerospace Defense Location will participate in an interactive Theater Missile Defense wargame with Air Force and Navy simulation facilities, and will demonstrate the integration of overhead and undersea surveillance. (\$4.0M)
- (U) The Simulation and Modeling Program will develop a prototype system supporting both analyses and man-in-the-loop exercises, including a distributed exercise. (\$6.8M)
- (U) The Special Materials Analysis program will continue investigation of the microballoon absorbing materials, ensure strict materials processing controls, and perform specific comparisons of these new materials with existing absorbers. (\$1.5M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

(U) FY 1995 Planned Program:

- (U) The Mountaintop program will move to the Pacific Missile Range Facility (PMRF) in Hawaii and begin collecting multi-channel radar data of advanced, low-flying targets in over-water and littoral environments. Emphasis will be on studying the impact of jamming and multipath on detection of sea skimming cruise missiles. (\$12.6M)
- (U) HAVE DUNGEON will establish the utility of integrated intelligence and conventional data source integration in the tactical environment. (\$2.0M)
- (U) The Simulation and Modeling Program will complete incorporation of ADI models in the simulation system. Man-in-the-loop exercises will address the value of new air defense technology concepts. (\$10.0M)
- (U) The Airborne Infrared Measurement System (AIRMS) will perform initial target data collection flights, and begin evaluation of operational algorithms for target characterization and recognition. (\$14.0M)

D. (U) WORK PERFORMED BY: The primary contractors for the efforts are: Westinghouse Airships Inc., Baltimore, MD and Weeksville, NC; Lockheed, Fort Worth, TX; Geodynamics, Colorado Springs, CO; SenCom and MIT/Lincoln Laboratories, Bedford, MA; and SAIC, McLean, VA and San Diego, CA. USAF Rome Laboratories, USAF Electronic Systems Command, USAF Wright Laboratories, and Naval Air Warfare Center, Aircraft Division provide agent support.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: The Special Materials Analysis program and the AIRMS program were not previously funded in EE-41.

F. (U) PROGRAM DOCUMENTATION: ADI Program Plan, August 1993.

G. (U) RELATED ACTIVITIES: ADI is part of a larger air defense technology program that includes EE-CLS/ADI funds.

H. (U) OTHER APPROPRIATION FUNDS: None.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of

Major Innovative Technologies

Project Number: EE-41 Date: February 1994

Budget Activity: 3. Advanced Development

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not Applicable.

J. (U) MILESTONE SCHEDULE:

Plan Milestones

Mountaintop Program:

Feb 94 Complete Space-Time Adaptive Processing (STAP) data base collection at White Sands Missile Range and initiate testing with advanced E-2C antenna.

Oct 94 Conduct sea-skimmer detection experiments at Pacific Missile Range Facility (PMRF).

Sep 96 Install the STAP processor with the Radar Surveillance Technology Experimental Radar at PMRF and initiate testing with advanced clutter and jamming rejection techniques.

Simulation and Modeling Program:

Jun 94 Conduct Simulation Program exercises with Air Force and complete ADI-specific RF and IR baseline models.

Aug 95 Complete two additional simulation baseline models and the prototype system.

Jul 96 Conduct distributed Air Defense Initiative exercises demonstrating new concepts from EE-CLS/ADI program element.

HAVE DUNGEON:

Apr 94 Perform Interactive Theater Missile Defense wargame experiment.

Jun 95 Prototype the system in exercise or operational demonstration.

Special Materials Analysis Program:

Aug 94 Definitize materials process controls for initial coating.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-41 Date: February 1994

PE Title: Experimental Evaluation of

Budget Activity: 3. Advanced Development

Major Innovative Technologies

Airborne Infrared Measurement System Program:

- Aug 95 Perform the initial target data collection flights and begin evaluation of operational algorithms for target characterization and recognition.
- Jun 96 Perform advanced target data collection flights, employ the data in the algorithms, and perform near real time demonstrations with operational algorithms.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of
Major Innovative Technologies

Project Number: EE-45

Date: February 1994

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project:

Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
EE-45 Global Grid Communications	0	19,209	48,487	51,926	49,842	43,592	7,435	0	220,494

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and shown to be applicable to advanced, high performance (and commercially available) networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technology developed elsewhere. The key elements are:

- (U) Applications such as intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action within 4 hours.
- (U) Advanced services such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level.
- (U) Demonstration networks that validate the Research and Development (R&D) and enable early application development and technology transition into DoD efforts such as Defense Information System Networks.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

Project Number: EE-45 Date: February 1994

Budget Activity: 3. Advanced Development

PE Title: Experimental Evaluation of

Major Innovative Technologies

- (U) Develop network controls pertaining to management, and security software technologies to enable sensor-to-shooter applications combining all network media.
- (U) Develop advanced optoelectronic network component technology and network architecture for scalable and modular networks. The aggregate network bandwidth will be in the range of tera bits per second and the network will handle Multi Media service for both digital and analog signals.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: New start in FY 1994.

(U) FY 1994 Planned Program:

- (U) Design the software architecture and conduct initial tests for joint task force planning/execution including weather, intelligence, strike planning and logistics. (\$10.7M)
- (U) Initiate network management, control, signaling efforts and demonstrate interoperability between commercial and DoD network assets. (\$4.9M)
- (U) Initiate optoelectronic network component technology development: switch, multiplexer, filter, amplifier and synchronizer. (\$3.6M)

(U) FY 1995 Planned Program:

- (U) Design and conduct initial assessments of information services for the defense internet; evaluate prototype software components in a software engineering testbed and during an operational exercise. (\$25.5M)
- (U) Integrate DoD and commercial networks and demonstrate services and network management in support of DoD experimental application with military attributes such as crypto surge capability. (\$5.0M)
- (U) Demonstrate advanced optical network capability and demonstrate multi-wavelength reconfigurable network architecture. (\$18.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E
PE Title: Experimental Evaluation of
Major Innovative Technologies
Project Number: EE-45 Date: February 1994
Budget Activity: 3. Advanced Development

(U) Program to Completion: This is continuing program.

D. (U) WORK PERFORMED BY: Competitive award of contracts. Major performers will include telecommunications, electronic and computing companies.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: New start in FY 1994.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: The program is coordinated with: The national High Performance Computing and Communication Program (that will provide theory and limited-area experience), the ARPA consortia on all-optical network and optoelectronic components, the component crypto development by NSA, and the JDL C3 and Computer Science panels. This program will produce the system technologies required by Global Surveillance and Communication thrust area activities.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Planned</u>	<u>Milestones</u>
Apr 95	Demonstrate optical component prototypes.
Jul 95	Multiple crisis scenario (integrated simulation and modeling tools, more powerful trade-off analysis).
Sep 95	Integrate defense high performance networks with crosscountry backbone using SONET/ATM. Early planning support demonstrations.
May 96	Demonstrate network combining crypto, commercial communications, and defense secure wireless, satellite.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603226E

PE Title: Experimental Evaluation of

Major Innovative Technologies

Project Number: EE-45 Date: February 1994
Budget Activity: 3. Advanced Development

May 97

Demonstrate integration with advanced optical testbeds. Large scale planning demonstrations.

Jul 97

Deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces).

May 98

Cross-country demonstration of optical and advanced network management.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #603226E Project Number: EE-46 (NEW START) Date: February 1994
 PE Title: Experimental Evaluation of Major Innovative Technologies Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Defense Simulation Internet (DSI) (NEW START)		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		Total	
Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Program
EE-46													
DSI													
*	31,617	15,855	26,200	37,000	-	-	-	-	-	-	-	-	110,672

*FY 1993 effort was funded in Project EE-37.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The goal of the Defense Simulation Internet (DSI) program is to research, develop and test at scale (worldwide), a network infrastructure capable of enabling distributed, real time, multi-media (video, voice, shared data and work spaces) simulation that will seamlessly integrate all simulation and modeling functions from early design to battle rehearsal enroute to the conflict. In its current state, the DSI is a collection of individual technologies that must be matured into a communications system. The communications needs of the distributed, real time, multi-media simulation community cannot be met with the available commercial technology, and while commercial vendors and standards bodies are pursuing some of the required technologies, the pace of this development is too slow to accommodate the immediacy of the Department of Defense's Simulation requirements. The DSI program is therefore accelerating the commercial development of the technologies needed by the simulation community for distributed work environments worldwide. Nearly 100 nodes currently extend the DSI to each of the Services, most of the Commanders-in-Chief (CinCs) and other Government affiliated sites. These locations constitute the network's test sites and provide valuable feedback on the technologies and methodologies being pursued.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #603226E
PE Title: Experimental Evaluation
of Major Innovative
Technologies

Project Number: EE-46 (NEW START) Date: February 1994
Budget Activity: 3. Advanced Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Planned Program: FY 1993 effort was funded within Project EE-37.

(U) FY 1994 Planned Program:

- (U) Implement interim upgrade to the network backbone (to 6 megabits per second (Mbps)) within the continental United States (CONUS) and install new backbone routers. (\$2.6M)
- (U) Upgrade the transatlantic and transpacific circuits and lease OCONUS circuits. (\$2.3M)
- (U) Lease approximately 140 communications lines (tail circuits) currently connecting the Defense Simulation Internet (DSI) sites to the network backbone. (\$3.1M)
- (U) Operate the Network Operations Center (NOC) to provide network engineering support, exercise engineering and onsite worldwide support, security management and oversight, user training and hotline support, network configuration management including inventory control, and network equipment maintenance. (\$8.6M)
- (U) Develop end-to-end encryption system capable of supporting extremely high speed networks. (\$4.8M)
- (U) Develop open system communications services software supportive of real-time, distributed, multi-media simulation requirements to support multicasting and resource management, and implement them on commercially marketed switchers and routers. (\$3.4M)
- (U) Develop premise routing devices: capable of handling extremely high data rates and communications protocols; capable of being installed, used and maintained at thousands of locations without onsite engineering support teams; with a cost reduction of at least 50% per device. (\$6.8M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #603226E

Project Number: EE-46 (NEW START) Date: February 1994

PE Title: Experimental Evaluation
of Major Innovative
Technologies

Budget Activity: 3. Advanced Development

(U) FY 1995 Planned Program:

- (U) Implement upgrade to the network backbone (to 45 Mbps) within the CONUS, procure and install new backbone switches. (\$3.0M)
- (U) Continue to lease OCONUS circuit and 140 tail circuits plus 40 new sites. (\$6.9M)
- (U) Continue to operate NOC to provide Operational Support. (\$5.9M)

(U) Program to Completion:

- (U) Continue to lease CONUS network backbone circuits, OCONUS circuits and 220 tail circuits plus 40 new sites. (\$18.9M)
- (U) Continue to operate NOC to provide Operations Support. (\$18.1M)

D. (U) WORK PERFORMED BY: Bolt, Beranek, and Newman in Cambridge, MA; Houston Associates, Incorporated in Arlington, VA and Leavenworth, KS; Titan Corporation in San Diego, CA; Trusted Information Systems in Greenbelt, MD; and Science Applications Corporation Incorporated in Arlington, VA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Not applicable.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: ARPA has established a joint program office with the Defense Information Systems Agency to ensure that there is no unnecessary duplication of research effort and to facilitate incorporation of the DSI into the Defense Information Systems Network after FY 1997.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #603226E
PE Title: Experimental Evaluation of Major Innovative Technologies
Project Number: EE-46 (NEW START) Date: February 1994
Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

Plan	Milestone
Feb 94	Transition Operations to Joint Program Office
May 94	Complete Interim Backbone Upgrade (6 Mbps)
Sep 94	Award Contracts for Encryption Efforts, Communications Services
Nov 94	Award Contracts for premise routing devices
Jan 95	Complete Backbone Upgrade (45 Mbps)
Jul 96	Complete Backbone Upgrade (155 Mbps)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

Project Number: AS-01 Date: February 1994

PE Title: Advanced Submarine Technology

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Submarine Technology

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
SUBTECH	52,239	44,194	25,261	19,473	24,311	28,449	36,230	Continuing	Continuing

SUBTECH

52,239 44,194 25,261 19,473 24,311 28,449 36,230 Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This program element is budgeted in The Advanced Development Budget Activity because its objectives are to develop and demonstrate advanced concepts and to pursue critical enabling technologies for future ship classes. The evolving worldwide threat of quiet diesel submarines and the proliferation of sophisticated submarine and weapons capabilities available to third world countries necessitates that the U.S. maintain a superior submarine force. U.S. submarine technologies must keep pace with changing threats and remain immune to technological surprises. The main thrust is to provide far-term solutions to increase ship affordability and provide enhanced capability to operate in this new environment by means of advances in structural vibration control, fluid/structure boundary interaction control and advanced materials.

(U) This program continues to develop and demonstrate innovative technologies initiated under active structural control, hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables. These technologies will significantly enhance submarine stealth and survivability. They also form the basis for efforts addressing affordability through improvements in high speed, ultrahigh precision machine tools used for fabricating noise-critical components, structural acoustic design capabilities, innovative machinery mounting systems, and high reliability propulsion systems incorporating active structural control. Advanced thick section composites and embedded sensors efforts are demonstrating the advanced structural fabrication processes and strength monitoring capabilities necessary to introduce affordable advanced lightweight structural materials into ship construction programs and efforts such as building dry deck shelters.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

Project Number: AS-01 Date: February 1994

PE Title: Advanced Submarine Technology

Budget Activity: 3. Advanced Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed corrosion studies to predict the calendar life of the advanced nickel-cadmium (Ni-Cd) battery.
- (U) Demonstrated Metal Oxide Semiconductor (MOS) Controlled Thyristor (MCT) and Auxiliary Resonant Commutated Pole in an adjustable speed 200 horsepower motor drive.
- (U) Completed testing of Active Impedance Modification (AIM) components, development of selected AIM algorithms, and fabrication and testing of prototype tile.
- (U) Demonstrated Advanced Vibration Reducer (AVR) on a Linear Test Rig; initiated fabrication of full scale components; transitioned AVR to Navy.
- (U) Completed initial precision machine tool measurements and developed specifications for an active vibration control system for affordable high precision fabrication of noise-critical machinery components.
- (U) Implemented mid-frequency structural acoustics code and developed a dimension-adaptive mesh generator for Stealth Designers' Workbench (SDW).
- (U) Completed feasibility report on active turbulence control; developed specifications for microelectro-mechanical (MEMS) sensor/actuator skin; demonstrated small scale Electromagnetic Turbulence Control (EMTC) technology for drag reduction.
- (U) Transitioned the Hydrodynamic/Hydroacoustic Technology Center (H/HTC) to Navy.
- (U) Continued development of structural modeling techniques required to analyze innovative ship construction and noise isolation technologies.
- (U) Designed and fabricated fiber placement and Resin Transfer Molding (RTM) articles with embedded sensors and conducted non-destructive evaluation testing of flat Resin Transfer Molding (RTM) panels 1 - 6" thick with embedded flaws, using ultrasonics, X-ray and thermography.
- (U) Designed, fabricated, and tested two and four foot non-autoclave cure spheres and cylinders; designed and fabricated two foot modular end dome (MED).

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01 Date: February 1994

Budget Activity: 3. Advanced Development

(U) FY 1994 Planned Program:

- (U) Fabricate non-autoclave cure thermoplastic-stiffened composite cylinders and spheres; begin testing thermoplastic cylinder and thermoset sphere; continue development of material properties characterization tools and Non-Destructive Evaluation (NDE) methods. (\$7.8M)
- (U) Continue fabrication of SUPRELITE components; complete SUPRELITE one-year fatigue test. (\$5.5M)
- (U) Continue design and fabrication of fiber placement cylinder and RTM articles with embedded sensors. (\$2.5M)
- (U) Implement automatic 3-D mesh generator for the Stealth Designer's Workbench (SDW). (\$3M)
- (U) Develop Active Structural Control (ASC) techniques for: a) shock attenuation and design of a concept demonstration system, b) suppression of blade resonance and resulting high cycle turbine fatigue failure, and c) active vibration isolation of electronics cabinets, and initiate concept demonstration system design. (\$8.0M)
- (U) Demonstrate feasibility of ASC chatter and vibration control for high speed, high precision machining operations. Formulate concepts for ASC of chatter in precision milling operations. (\$2.0M)
- (U) Demonstrate active sound isolation through magnetic levitation. (\$3.4M)
- (U) Complete 50:1 scale model tests and numerical simulations for hull response to lightweight structures and complete truss beam damping tests, design of truss attachment and numerical simulations. (\$6.0M)
- (U) Fabricate and test active smart skin and Electromagnetic Turbulence Control (EMTC) concepts. (\$3.4M)
- (U) Expand on technology developed in thick composites program and initiate fabrication of one Dry Deck Shelters (DDS) and test vehicle. (\$4.3M)
- (U) Evaluate advanced stealth, signature control, communications, materials, and producibility technologies to enhance submarine performance in littoral warfare. (\$1.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01 Date: February 1994
Budget Activity: 3. Advanced Development

(U) FY 1995 Planned Program:

- (U) Develop and test active shock attenuation techniques. Initiate design of a thermally boosted acoustic source for stealth applications. (\$2.5M)
- (U) Conduct a full scale demonstration of Active Structural Control (ASC) for turning and boring applications. Initiate feasibility demonstration of ASC concepts for high speed milling. Develop ASC grinding operations. (\$1.1M)
- (U) Initiate feasibility demonstration system for ASC concepts reducing turbine blade resonance. Develop ASC techniques for isolating turbine rotating components. (\$1.0M)
- (U) Demonstrate active fluid/structure boundary (flow) control concepts at laboratory scales. (\$1.0M)
- (U) Complete design and fabrication of 1/4-scale model for lightweight structures and complete truss testing and numerical simulations. (\$4.0M)
- (U) Complete fabrication and initiate installation of SUPRELITE. (\$2.4)
- (U) Complete fabrication, assembly and test of thick composite subscale components and a cylinder with embedded sensors, and refinement of sensor demodulation and non-destructive evaluation (NDE) methods. (\$6.0M)
- (U) Develop large scale, curved surface application of Electromagnetic Turbulence Control (EMTC). (\$2.0M)
- (U) Conduct initial demonstration of individual submarine stealth and littoral warfare operational enhancing technologies. (\$5.3M)

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Metron, Inc., Reston, VA; SAIC, San Diego, CA; GEC-Marconi, United Kingdom; Pennsylvania State University/Applied Research Laboratory, State College, PA; AT&T Bell Laboratories, Whippany, NJ; United Technologies, Pratt and Whitney, West Palm Beach, FL; McDonnell Douglas Aircraft, St. Louis, MO; Johns Hopkins University/Applied Physics Laboratory, Laurel, MD; General Dynamics/Electric Boat Division, Groton, CT; Los Alamos National Laboratory, Los Alamos, NM.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01 Date: February 1994

Budget Activity: 3. Advanced Development

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: This program is a continuation of the Congressionally mandated Submarine Technology Program (STP).

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This program has been coordinated with the Program Executive Officer, Submarines (PEO-SUB-R) to ensure there is no duplication of effort and that developed technologies are properly transitioned to the Navy.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Feb 94	Complete testing of the first thick composite 4-foot diameter thermoplastic sphere.
Apr 94	Complete SUPRELITE one year qualification fatigue tests.
Jul 94	Concept feasibility demonstration of precision machining turning and boring operations.
Nov 94	Concept feasibility demonstration of electronics cabinet vibration isolation system.
Nov 94	Complete fabrication of full scale SUPRELITE rotor.
Dec 94	Concept feasibility demonstration of active shock attenuation system.
Apr 95	Installation and initial at-sea test of full scale SUPRELITE rotor. Transition to Navy.
Aug 95	Factory floor demonstration of precision machining turning and boring operations.
Sep 95	Concept feasibility demonstration of active control of turbine blade resonance vibrations.
Feb 96	Full-scale demonstration of active shock attenuation system.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603569E

PE Title: Advanced Submarine Technology

Project Number: AS-01

Date: February 1994

Budget Activity: 3. Advanced Development

Jun 96	Complete testing of integrated 1/4-scale lightweight truss structures.
Jul 96	Concept feasibility demonstration of thermo-acoustic source noise cancellation system.
Aug 96	Full-scale demonstration of active control of turbine blade resonance vibration.
Sep 96	Factory floor demonstration of precision machining milling operation.
Jun 97	Full-scale demonstration of thermally boosted acoustic source for stealth applications.
Aug 97	Factory floor demonstration of active vibration control system for precision grinding operation.
Aug 98	Full-scale demonstration of turbine active vibration control system for engine mounts and external components.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Date: February 1994

PE Title: Electronics Manufacturing Technology Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MT-01 Microelectronics Manufacturing	0	0	0	3,045	11,500	13,500	6,450	0	34,495
MT-02 Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC)	81,579	79,881	25,183	0	0	0	0	0	272,169
MT-03 IR Focal Plans Array (IRFPA)	34,150	41,429	44,809	43,200	14,400	0	0	0	196,118
MT-04 Electronic Module Technology	66,506	117,580	130,930	146,512	85,826	149,502	149,472	Continuing	Continuing
MT-05 Tactical Display Systems	10,078	9,382	16,210	21,161	22,169	19,735	13,500	Continuing	Continuing
MT-06 Microwave and Analog Front End Technology (MAFET)	0	0	24,475	54,489	68,296	67,751	50,201	Continuing	Continuing
MT-07 Centers of Excellence	27,664	23,837	15,000	15,000	10,000	0	0	0	91,501
MT-08 Manufacturing Technology Initiatives	0	6,741	14,342	27,800	32,112	35,920	25,000	0	141,915

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Date: February 1994
 PE Title: Electronics Manufacturing Technology Budget Activity: 3. Advanced Development

MT-09	Dual-Use Design and Manufacturing Technology	0	25,180	44,742	46,751	34,235	15,000	Continuing	Continuing
MT-10	*Advanced Lithography (71,273)	58,386	10,000	25,000	25,000	25,000	25,000	Continuing	Continuing
MT-11	Computer-aided Acquisition and Logistics Support (CALS)	0	43,000	20,000	15,000	15,000	0	0	133,000
Total		219,977	380,236	346,129	400,949	331,054	360,643	284,623	

*Previously funded in PE 0602712E, Project MPT-04.

B. (U) BRIEF DESCRIPTION OF ELEMENT: The Electronics Manufacturing Technology program element is budgeted in the Advanced Development Budget Activity because it seeks to design and demonstrate state-of-the-art manufacturing and process technologies for the production of various electronics and microelectronic devices, sensor systems, actuators, gear drives that have both commercial and military applications. Introduction of advanced product design capability and flexible, scalable manufacturing techniques will enable the commercial sector to rapidly and cost-effectively satisfy military requirements and enhance the U.S. industrial base.

(U) The objective of the Microwave/Millimeter Wave Monolithic Integrated Circuits (MMIC) project is to accelerate the development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits. This technology will be the basis for the efforts in the Microwave and Analog Front End Technology (MAFET) program (MT-06) beginning in FY 1995. The MAFET program will further enhance microwave and millimeter wave module performance at reduced costs.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

(U) The IR Focal Plane Array project focuses on the establishment of a manufacturing base for advanced infrared sensor arrays for major weapons systems. This base will allow the systems to meet operating requirements at approximately 1% of the current cost.

(U) The goal of the Electronic Module Technology project is to allow for the timely insertion and rapid acquisition of state-of-the-art microprocessors and actuators, conformal electronics and affordable, high performance application specific electronic module (ASEM), components into major military systems. These systems include automatic target recognition, electronic counter-measures and Signal Intelligence (SIGINT). This project includes Advanced Technology Demonstrations (ATDS) in ASEM and Rapid Prototyping of Application Specific Signal Processor (RASSP).

(U) Tactical Display Systems projects develop and demonstrate high definition miniature displays to provide visual information to individual combatants and small groups who are remotely located from conventional visual information sources.

(U) The Centers of Excellence program finances demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life cycle costs while improving quality.

(U) The goal of the Manufacturing Technology Initiatives program is to reduce the cost and acquisition leadtime of future military systems by integrating manufacturing process considerations during the product design phase, and by demonstrating high efficiency multi-product prototype factories. The project funds two Advanced Technology Demonstrations, the Active Electronically Scanned Arrays (AESA) project and the Flexible Design and Assembly of Missile and Munitions Seekers (FDAMMS) project, to provide practical examples of these concepts.

(U) The Dual-Use Design and Manufacturing project will enable manufacturers to economically produce military variants of their commercial products in limited quantities through the introduction of flexible process technologies. Key concepts that are integral to dual-use manufacturing capability such as advanced design systems scalable components and subsystems,

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Date: February 1994

Budget Activity: 3. Advanced Development

flexible factory systems, and improved manufacturing operations control will be demonstrated in two for sub-projects: the Interferometric Fiber Optics Gyroscopes (IFOG) and Manufacturing Systems Technology Electric Drive System (MSTEDS) projects.

(U) Advanced Lithography technology has enabled the dramatic growth of integrated circuit (IC) capability. Advances have lead directly to improvements in electronic and computing systems performance in terms of speeds, power, weight and reliability.

(U) The goal of the Computer-aided Acquisition and Logistic Support (CALS) initiative is to transition DoD's current paper intensive weapon system support processes to a highly automated and integrated mode of operation. The transition will result in a fundamental change in the way DoD and industry use and distribute technical information, improving the quality and productivity of weapon system development and support.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-02 Date: February 1994
PE Title: Electronics Manufacturing Budget Activity: 3. Advanced Development Technology

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Microwave/Millimeter Monolithic Integrated Circuits									
Popular Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
MT-02									
	MIMIC								
	81,579	79,881	25,183	0	0	0	0	0	571,439

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This project provides for the acceleration of development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (ICs). The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is providing previously unavailable microwave and millimeter-wave integrated circuits to enable DoD systems to meet size, weight and power constraints at the lowest possible cost. Its primary thrust is to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and in sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations will be accelerated and, thus provide the United States with a technological lead in deploying MIMIC-based military systems.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Delivered first multi-function MIMICs meeting required system specifications.
- (U) Began assembly of advanced MIMIC modules and system brassboards.
- (U) Continued development of advanced materials, devices, design software, packaging and testing technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-02

Date: February 1994

Budget Activity: 3. Advanced Development

(U) FY 1994 Planned Program:

- (U) Continue work on MIMIC Phase 2 contracts including delivery of process demonstration wafers, completion of MIMIC Phase 2 chip fabrication and continue assembly of MIMIC modules and brassboards.

(U) FY 1995 Planned Program:

- (U) Completion of program including delivery of MIMIC chips, modules and brassboards and demonstrations of advanced technology and hardware.

D. (U) WORK PERFORMED BY: In-house work will be performed by: Army Research Laboratory; Naval Air Systems Command; U.S. Naval Research Laboratory; Air Force Wright Laboratory, and Rome Laboratory. Hardware development phase prime contractors are: Hughes Aircraft Company, El Segundo, CA; General Electric, Syracuse, NY; Martin-Marietta, Orlando, FL; ITT, Roanoke, VA; Raytheon Co., Bedford, MA; Texas Instruments, Dallas, TX; and TRW, Redondo Beach, CA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: The change in total program cost reflects the results of a phased completion of the MIMIC program.

F. (U) PROGRAM DOCUMENTATION:

- (U) Management structure for the Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) Program, 9/85.
- (U) Program Plan for MIMIC, 5/86.
- (U) Acquisition Plan No. DoD 86-X for MIMIC Program, 10/86.

G. (U) RELATED ACTIVITIES: Exploratory and advanced development of gallium arsenide monolithic components are being undertaken within the following Army, Navy, Air Force RDT&E program elements:

- (U) Program Element #0602705A, Electronics and Electronic Devices
- (U) Program Element #0602234N, Systems Support Technology
- (U) Program Element #0602204F, Aerospace Avionics

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-02

Budget Activity: 3. Advanced Development

Date: February 1994

(U) The work performed within this project is complementary to the work performed in the Service program elements. MIMIC is a ARPA funded and managed/Tri-Service coordinated program. Each of the Military Departments has set up a MIMIC Program Office to provide management and support for the MIMIC Program's contractual efforts.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Jun 94	Complete fabrication of MIMIC chips.
Jan 95	Deliver MIMIC Phase 2 chips, modules and brassboards.
Jan 95	Complete integrated design/fabrication/test capabilities at MIMIC Phase 2 contractors.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-03

Date: February 1994

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: IR Focal Plane Array

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MT-03									
IRFPA									
	34,150	41,429	44,809	43,200	14,400	0	0	0	196,118

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Infrared Focal Plane Array (IRFPA) project establishes a manufacturing base for advanced infrared (IR) sensor arrays required for major weapon systems. Improvements in infrared materials, detector array fabrication, read-out electronics, cryogenic testing and module assembly are addressed in order to provide affordable infrared sensors to system developers. Systems requiring affordable tactical infrared focal plane arrays include missile seekers, airborne and ground-based target acquisition systems, and infrared search and track systems. Currently, the IRFPAs are produced at low rates and high cost with technology that is just emerging from the laboratory environment. The goal of this project is to produce IRFPAs that meet system requirements with a hundred-fold cost reduction relative to the cost at the beginning of the project. The project reflects the OSD Advanced Technology Demonstration for scalable IRFPA manufacturing.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Demonstrated vapor phase growth of cadmium zinc telluride on silicon substrates to produce large-area long-wavelength staring arrays.
- (U) Demonstrated improved screening of IR material; x2 increase in the arrays passing wafer-level evaluation.
- (U) Manufactured large, 480x4, scanning IRFPAs with improved reliability (greater than 1,000 thermal cycles without failure).

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-03

Date: February 1994

Budget Activity: 3. Advanced Development

- (U) Implemented manufacturing technology using a two-inch substrate, which contains more than 60 64x64 IRFPAs.
- (U) Implemented improved control over infrared material growth process as initial demonstration of flexibility in IRFPA manufacturing.
- (U) Initiated activity for a physical model describing defects in IR material as the initial step toward flexible IRFPA manufacturing.

(U) FY 1994 Planned Program:

- (U) Demonstrate improved wafer morphology to reduce defect density in long-wavelength staring arrays. (\$4.0M)
- (U) Complete physical model describing IR detector defect generation. (\$1.0M)
- (U) Fabricate scanning and staring modules for tactical applications. (\$15.0M)
- (U) Complete read-out circuit design and fabricate read-out for mid- and long-wavelength devices. (\$6.0M)
- (U) Demonstrate long wavelength scanning arrays with cut-off wavelength of 11.0 microns at 68 Kelvin. (\$5.5M)
- (U) Laboratory demonstration of flexible IRFPA manufacturing processes. (\$7.0M)
- (U) Complete flexible IRFPA manufacturing line design. (\$3.0M)

(U) FY 1995 Planned Program:

- (U) Demonstration of one-hundred times (X100) cost reduction for 480x4 infrared focal plane arrays useful for ground and airborne applications. (\$9.8M)
- (U) On-line demonstration of electrical functionality probing of detector arrays on wafers. (\$3.0M)
- (U) Demonstration of 128x128 infrared focal plane array with improved spatial uniformity for missile seeker applications. (\$5.0M)
- (U) Integration of completely dry processing into the infrared detector fabrication line. (\$7.0M)
- (U) Laboratory demonstration of cluster tool concept for flexible manufacturing. (\$20.0M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-03

Date: February 1994

Budget Activity: 3. Advanced Development

(U) Program to Completion:

- (U) Demonstrate large-area 480x640 mercury cadmium telluride IRFPAs on a silicon substrate.
- (U) Demonstrate manufacturing technology for 64x64 staring arrays with greater than 95% operability at a cost of less than \$2,000 per IRFPA.
- (U) Demonstrate 128x128 IRFPAs on a silicon substrate for greater ease of material handling and compatibility with commercial manufacturing equipment.
- (U) Demonstrate IRFPA manufacturing with 4-inch wafers.
- (U) Complete the development of an integrated manufacturing capability for large-area (4-inch diameter) infrared sensitive semiconductor wafers demonstrating a 100 times cost reduction for both staring and scanning arrays.
- (U) Demonstrate flexible, modular IRFPA manufacturing with the capability to rapidly reconfigure the line to produce 3-5 and 8-12 micron arrays for tactical and space surveillance applications.

D. (U) WORK PERFORMED BY: Contractors include: Santa Barbara Research Center, Santa Barbara, CA; Loral Infrared and Imaging Systems, Lexington, MA; Rockwell, Anaheim, CA; Texas Instruments, Dallas, TX; Hughes Research Lab, Malibu, CA; and Martin Marietta, Orlando, FL and Schenectady, NY.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Consistent with the FY 1994 Descriptive Summary.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Development of Infrared Focal Plane Array (IRFPA) technology and devices is being undertaken under Army, Navy, Air Force and Advanced Research Projects Agency (ARPA) program elements. The related Service program elements are:

- (U) PE 0602709A, Night Vision Technology.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing Technology
Project Number: MT-03 Date: February 1994
Budget Activity: 3. Advanced Development

- (U) PE 0603774A, Night Vision System Advanced Development.
- (U) PE 0602234N, Systems Support Technology.
- (U) PE 0602204F, Aerospace Avionics.

(U) The project supports development of flexible IRFPA manufacturing, capable of meeting tri-Service requirements. All Service and ARPA efforts are closely coordinated to assure that there is no duplication of effort.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Aug 94	Demonstrate a 100 times cost reduction in the manufacture of two-dimensional, staring IRFPAs.
Sep 95	Assemble scalable focal plane array facility.
Jan 96	Demonstrate process module concept for multi-purpose scanning arrays.
Jun 96	Demonstrate equipment with flexibility to produce various IRFPA configurations on the same line.
Sep 96	Demonstrate large-area staring and scanning array for search and track, target acquisition, and missile seeker systems.
Sep 97	Demonstrate high-yield IRFPA manufacturing facility capable of varying production rates from small lots to high throughput rates.
Dec 97	Completion of modular infrared focal plane array manufacturing capability, scalable from low volume (single wafer processing) to higher production volume (ten wafer lots @ over 10,000 wafers per year); with single wafer cycle time of ten days.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronic Manufacturing Technology

Project Number: MT-04

Date: February 1994

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Electronic Module Technology

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MT-04	Electronic Module Technology	66,506	117,580	130,930	146,512	85,826	149,502	149,472	Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Electronic Module Technology Project is a broad initiative to substantially decrease the cost while increasing the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the interconnection and physical packaging of various types of digital and analog integrated circuits, as well as other electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards, emerging technologies such as high density multichip modules (MCMs), and revolutionary approaches such as "conformal electronics".

(U) The project has four major objectives: (1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; (2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; (3) provide a robust manufacturing infrastructure for electronic modules; and (4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs).

(U) The project has the following major elements: (1) High-Density Physical Packaging; (2) Application Specific Electronic Modules (ASEM); (3) Multichip Integration (MCI); (4) Rapid Prototyping of Application Specific Signal Processors (RASSP); and (5) Microelectromechanical Systems (MEMS). High-density physical packaging will develop and exploit high-density packaging

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronic Manufacturing Technology

Project Number: MT-04

Date: February 1994

Budget Activity: 3. Advanced Development

technology for digital and mixed analog/digital electronics with clock rates up to several GHz and manufacturing processes that will lead to the production of complex shape, lightweight, and high density microwave frequency multichip modules and sub arrays. ASEM will reduce the non-recurring engineering time and cost for designing and inserting complex electronic modules. MCI will produce order of magnitude reductions in manufacturing cost and to accelerate the acceptance and insertion of multichip integration technologies. RASSP is a major new ARPA/Tri-Service initiative which seeks to dramatically reduce the development time and life cycle cost of advanced signal processing capability while ensuring state of the art performance when the processor is fielded, not just when it is first defined. MEMS supports information technology for mobile systems and active individuals: microdynamics devices and systems, wireless/low-power communication and conformal/embedded manufacturing.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Established merchant multichip module (MCM) prototype production and initiated High-Density Microwave Packaging Program.
- (U) Continued the ASEM Program with the establishment of three merchant foundries and the initiation of CAD tool development.
- (U) Initiated the MCI program with the establishment of a Flip-Chip Center and funding of innovative manufacturing equipment and multichip module insertions.
- (U) Awarded RASSP primary development contracts along with technical base and benchmark efforts.
- (U) Integrated MEMS multiple device simulators into a common description language and selected defense-relevant microdynamic array applications.

(U) FY 1994 Planned Program:

- (U) Continue development and demonstration of 10-100X packaging density improvement for digital processors, memories, and analog circuits operating at clock rates up to 500 MHz. (\$5.9M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronic Manufacturing Technology

Project Number: MT-04

Date: February 1994

Budget Activity: 3. Advanced Development

- (U) Continue the ASEM program with addition support for the flexible-access foundry system focusing on the board level integration of MCMs. (\$25.4M)
 - (U) Continue the MCI program with the establishment of large format equipment development programs and the initiation of selected MCM insertions. (\$28.9M)
 - (U) Expand RASSP technical base development and demonstrate first versions of design environment, circuits and virtual prototypes. (\$37.3M)
 - (U) Initiate environmental conscious electronics systems manufacturing (\$20.0M)
- (U) FY 1995 Planned Program:
- (U) Continue development of microwave frequency multichip module housings, internal packaging interconnections, array interconnect technology, module assembly and integration and CAD tools and databases. (\$5.0M)
 - (U) Continue the ASEM program with heightened emphasis on mixed signal modules and application demonstrations. (\$29.1M)
 - (U) Continue the MCI program with further development of manufacturing equipment and focusing on the delivery of production modules for military aircraft and other dual-use applications. (\$25.0M)
 - (U) Deliver preliminary RASSP benchmark evaluations and demonstrate improved CAD technology, VHDL extensions, advanced algorithms, and improved design environment. Complete first RASSP system demonstration hardware. (\$46.8M)
 - (U) Develop high-yield, high-uniformity, high aspect-ratio fabrication processes for Microelectromechanical Components and Systems and merge with related fabrication technologies in optics, optoelectronics and microwave devices. (\$25.0M)

(U) Program To Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: Major contractors include: Texas Instruments, Dallas, TX; N-chip, San Jose, CA; Motorola Corp., Chandler, AZ; IBM Corp., Manassas, VA and East Fishkill, NY; Martin-Marietta Corp, Moorestown, NJ; Lockheed Sanders Inc., Nashua, NH; and E-Systems Inc., Greenville, TX. Additional contractors will be determined by competitive selection. In-house work,

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronic Manufacturing Technology

Project Number: MT-04

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Budget Activity: 3. Advanced Development

including management and support of contractual efforts will be performed by: Department of the Army, U.S. Army Laboratory Command, Ft Monmouth, NJ; Naval Air Systems Command; and the Air Force, Wright Laboratories.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Increased funding in FY 1995 incorporating microelectromechanical systems (MEMS) and Multi-Chip Integration demonstrations.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: This effort will be closely coordinated with Program Element 0602301E, ST-19, High Performance Computing and Communications (HPCC) and Program Element 0603739E, MT-05, Tactical Display Systems (TDS) programs which will provide applications for demonstrating the new technologies.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Nov 93	Integrate first version of RASSP design environment.
Feb 94	Fabricate and test first RASSP signal processing circuits.
Jun 94	Deliver first ASEM Modules for dual use application.
Jun 94	MCI Manufacturing Technology Demonstrations.
Jun 94	First virtual prototype of RASSP System demonstration design.
Feb 95	Demonstrate ASEM \$50,000 non-recurring engineering cost 60 day cycle time for 10 chip Multichip Modules.
Mar 95	Demonstrate MCM insertions in OH-58D Image Processor.
Mar 95	Establish quick-turnaround SEM-E board foundry.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronic Manufacturing Technology

Project Number: MT-04

Budget Activity: 3. Advanced Development

Date: February 1994

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| Sept 95 | Complete high density microwave packaging (HDMP) initial development of housings, inter-chip and inter-layer interconnections and testing. |
| Sept 95 | Complete HDMP developments of initial versions of specialized microwave packaging CAD tools and databases. |
| Mar 96 | Demonstrate improved versions of RASSP design environment. |
| Jun 96 | Complete HDMP final development of housings, interconnect approaches and perform initial module testing. |
| Aug 96 | Begin assembly of HDMP brassboard array and perform initial testing. |
| Sept 96 | Deliver MCI Manufacturing Technology to the dual-use market. |

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-05 Date: February 1994
Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Tactical Display Systems (TDS)

Popular Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
MT-05									
Tactical Display Systems (TDS)									
	10,078	9,382	16,210	21,161	22,169	19,735	13,500		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: This project is a major DoD effort to develop the technology for displays and portable information systems for use in a variety of military systems. This technology is important for virtually all DoD applications which involve visual and graphic information. Major applications of this technology include small combat durable displays for head mounted, hand held, or otherwise portable systems that will be used in aircraft and helicopter cockpits, armored vehicles, submarines, AEGIS cruisers, aircraft carrier flight decks, military simulators, command centers and individual infantrymen. This technology will provide greater resolution for the smaller intelligence and reconnaissance platforms required for potential future conflicts and greater combat durability for these display systems based upon modular design concepts. A major objective of this program is to develop small displays and to integrate these into ongoing and future military portable information systems to significantly improve mission effectiveness for individual combatants and small groups.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Head Mounted Displays - This effort will develop small format, lightweight, high-resolution head mounted display systems. Emphasis in this fiscal year is on the development of the small displays, design of a "goggle" mounting configuration and supporting technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-05 Date: February 1994
Budget Activity: 3. Advanced Development

(U) FY 1994 Planned Program:

- (U) Head Mounted Displays - Emphasis in this fiscal year will be on the completion of the small format displays, head mounted apparatus, and system interfaces for a Combat Vehicle Crew Head Mounted Display. (\$9.4M)

(U) FY 1995 Planned Program:

- (U) Head Mounted Displays - Emphasis will be on demonstrating a Combat Vehicle Crew Head Mounted Display System and initiating a super high-resolution, small format display development. (\$10.3M)
- (U) Tactical Information Assistants - This effort will develop light, thin, portable information systems for active, mobile users that focus on rapid prototyping with end-users in the design loop. Emphasis will be on modifying a field qualified, hand-held laser rangefinder to provide improved surveillance information gathering and transmission. (\$5.9M)

- (U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: The major performers are: Kopin Corporation, Taunton, MA; Planar Systems, Beaverton, OR; David Sarnoff Research Laboratory, Princeton, NJ; Honeywell Systems and Research Center, Bloomington, MN; Motorola, Inc., Phoenix, AZ; and MIT, Boston, MA.

(U) Service support is provided by U.S. Army Natick RDT&E Center, Natick, MA and a Joint Service Head Mounted Display Working Group consisting of members from Army, Navy, Air Force, and NASA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Increased funding in FY 1995 for initiation of Tactical Information Assistant program.

F. (U) PROGRAM DOCUMENTATION: None.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-05 Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

G. (U) RELATED ACTIVITIES: This project is coordinated with the Army, Navy, Air Force and NASA through the Joint Service Head Mounted Display Working Group. There is no joint funding nor any duplication of effort involved with Service efforts in this technology.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Sep 94	(U) Complete development of 1280x1024 pixel 1-inch displays
Dec 94	(U) Complete development of head mounted mechanical configuration with optics and initiate modification of hand-held laser rangefinder
Nov 94	(U) Initiate super high-resolution display development
Dec 94	(U) Demonstrate CVC HMD
Jun 95	(U) Demonstrate "eyeglass-like" displays
Nov 96	(U) Demonstrate modification of hand-held laser rangefinder

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-06 (New Start) Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Microwave and Analog Front End Technology (MAFET)

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MT-06 MAFET	0	0	24,475	54,489	68,296	67,751	50,201		Continuing Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Microwave and Analog Front End Technology (MAFET) program will build upon the established MIMIC technology base to enhance current microwave and millimeter wave technology and manufacturing capabilities. This is the only program of significant size in this technical area and it is the most cost effective and efficient means for meeting the microwave and millimeter wave frequency component needs of the Department of Defense (Army, Navy, Air Force, ARPA, and National Security Agency). The work to be undertaken is essential in order to simultaneously achieve the further cost reductions and performance enhancements of the circuits, modules, and subsystems that will be needed, to maintain an adequate level of defense through upgrading current DoD systems. The work is also necessary to allow the cost-effective development of future DoD systems with needed but presently unavailable capabilities. The program has several objectives: (1) further cost reduction of microwave monolithic integrated circuits and mixed-signal multi-chip assemblies while simultaneously meeting more demanding (e.g. higher power, higher efficiency, higher frequency) system performance requirements and achieving higher levels of component integration. This, in turn, will provide the required performance capabilities at an affordable cost and with maximum portability for systems such as active electronically scanned radars, secure, low power communications, and advanced identification friend-or-foe system; (2) development of low cost advanced millimeter-wave frequency sensors needed to provide currently unavailable and urgently needed DoD system capabilities including increased accuracy smart-weapons and all-weather vision

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-06 (New Start) Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

systems; and (3) enhancement of the design, fabrication, testing, and assembly infrastructure capabilities to maintain U.S. world dominance in the microwave and millimeter wave monolithic integrated circuit area.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: Not applicable.

(U) FY 1994 Planned Program: Not applicable.

(U) FY 1995 Planned Program:

- (U) Begin development of advanced design, fabrication, testing and assembly capabilities required to more efficiently produce required microwave and millimeter wave circuits, modules and sub-systems. (\$12.0M)
- (U) Begin development of enhanced millimeter wave frequency integrated circuits that make use of advanced materials such as indium phosphide (InP). (\$8.0M)
- (U) Begin procurement for next stage of Microwave Hardware Description Language development. (\$1.0M)
- (U) Begin development of advanced, low cost, microwave MMICS. (\$3.5M)

(U) Program To Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: All contracts will be competitively selected. In-house work, including management and support of contractual efforts will be performed by: Advanced Research Projects Agency (ARPA); Department of the Army, U.S. Army Research Laboratory; Department of the Navy, Naval Air Systems Command and Naval Research Laboratory; and Department of the Air Force, Wright Laboratories and Rome Laboratories.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-06 (New Start) Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: This project provides technology and components that may be used in conjunction with those developed under the following other programs within this PE (Project MT-04) for improvement of DoD systems; Microelectromechanical Systems (MEMS), and RASSP.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

<u>Milestones</u>	
<u>Plan</u>	
Nov 94	Initiate first RFP or BAA for MAFET development contracts.
May 95	Award first MAFET development contracts.
Nov 95	Initiate additional RFP or BAA for MAFET development contracts.
May 96	Award second MAFET development contracts.
Dec 96	Demonstrate enhanced mm-wave frequency integrated circuits.
Dec 96	Demonstrate extensions of design, fabrication, testing and assembly capabilities.
Mar 97	Demonstrate efficient, low cost, manufacturing and assembly approaches for highly integrated microwave circuit and module assemblies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E Project Number: MT-07 Date: February 1994
PE Title: Electronics Manufacturing Technology Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title:		FY 1993		FY 1994		FY 1995		FY 1996		FY 1997		FY 1998		FY 1999		Total	
Popular Name	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Program
MT-07		Centers of Excellence															
	27,664	23,837	15,000	15,000	15,000	10,000	0	0	0	0	0	0	0	0	0	0	91,501

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This project provides funding for three Technology Centers of Excellence: The National Center for Coal Utilization at Pennsylvania State University; Robert C. Byrd Institute for Advanced Manufacturing at Marshall University; and the Focus: Hope Center for Advanced Technologies in Detroit, Michigan. The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems.

(U) The National Center of Excellence for Coal Utilization is a consortium whose purpose is to expand the use of anthracite and bituminous coals.

(U) The Institute for Advanced Flexible Manufacturing Systems provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness.

(U) The Center for Advanced Technology is a component of the Focus: Hope Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research. The three program elements include: development of world-class manufacturing training/education to expand on current programs; development of a world-class flexible computer integrated manufacturing facility supporting education under full-scale production conditions;

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-07 Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

and development of an aggressive technology outreach program, serving to demonstrate the results of manufacturing research and integration technologies under production conditions, and to serve as a technology transfer activity.

(U) The FY 1995 program provides continued support for the Center for Advanced Technology. These funds will be used to acquire computer integrated manufacturing systems including computers, software, scheduling systems, and statistical process control software.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Completed the staffing of engineering management and dean of education at National Center for Advanced Technology (NCAT).
- (U) Demonstrated the full art-to-part capability of automotive parts manufacture.
- (U) Provided manufacturing process support to a regional manufacturer from the Robert C. Byrd Institute for Advanced Technology.
- (U) Completed curriculum development for hands-on production center manufacturing systems training supporting certificate, associates, bachelors and masters degrees.
- (U) Developed further reductions in gaseous and particulate emission when firing coal-based fuels in industrial-scale boilers.
- (U) Prepared and characterized fuels compatible with coal pre-combustors.
- (U) Investigated pre-combustion as a means of using high ash and sulfur coals.

(U) FY 1994 Planned Program:

- (U) Develop contracts, determine manufacturing requirements, purchase the install manufacturing equipment and enter production for the 4th through 7th of the eleven planned manufacturing neighborhoods at NCAT increasing overall defense production rates to 10,000 parts per month. (\$19.8M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-07

Date: February 1994

Budget Activity: 3. Advanced Development

- (U) Institute for Advanced Flexible Manufacturing. Continuation of the ongoing technology development, technology evaluation, and technology transfer to local business. Provide system integration, support CALS commercialization, client assistance for federal contracts, technology training through seminars and workshops, and research into dual-use flexible manufacturing. (\$4.0M)

(U) FY 1995 Planned Program:

- (U) Complete the installation of the 8th through 10th of the eleven planned manufacturing neighborhoods at NCAT. (\$15.0M)

(U) Program to Completion: Transfer of technology will be completed from NCAT. This program is completed in FY 1997.

D. (U) WORK PERFORMED BY: PROJECT: FOCUS HOPE, Detroit, MI; Center of Excellence and Coal Utilization, University Park, PA; and Marshall University, Huntington, WV.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Funds added in FY 1994 (\$15M - Congressional Addition), FY 1995 (\$15M), and FY 1997 (\$10M).

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Capabilities that will be deployed to centers of excellence include technologies developed under project #MT-08, Manufacturing Technology Initiatives.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics Manufacturing Technology
Project Number: MT-07 Date: February 1994
Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Sep 94	Complete installation of the 4th through 7th manufacturing neighborhoods.
Sep 95	Complete installation of the 8th through 10th manufacturing neighborhoods.
Sep 96	Complete the lost manufacturing neighborhood and the final funding for the NCAT.
Sep 96	Identify and transition manufacturing technology to regional manufacturing centers.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-08

Date: February 1994

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Manufacturing Technology Initiative

Popular Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
MT-08									
Manufacturing Technology Initiative									
0	6,741	14,342	27,800	32,112	35,920	25,000	0		141,915

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: Future military systems, such as sensors and missile seekers, will be affordable only if the manufacturing process is considered as an integral part of product design and if production takes place in flexible, multi-product factories. The program focus is on process technology demonstrations, providing prototype flexible factories with integrated design and manufacturing systems as well as prototype products. Included are the initiation of an Advanced Technology Demonstration (ATD) and additional technology base demonstrations of a prototype networked manufacturing systems infrastructure. The networked infrastructure will link computer aided design, engineering, and analysis with manufacturing systems, and will more effectively integrate dissimilar design and manufacturing systems for both military and commercial use.

(U) The ATD is Flexible Design and Assembly of Missile and Munition Seekers (FDAMMS). FDAMMS will develop and integrate design and flexible manufacturing systems including automated design-for-assembly tools, factory planning and control systems, advanced factory simulations, flexible high precision assembly and checkout systems to demonstrate the capability to reduce the cost of complex electro-mechanical products with missile and munition seeker assemblies as initial targets. These programs will establish new benchmarks for cost and schedule reduction in the tactical missile industry sector. Vendor involvement will result in design and manufacturing systems which can be applied to numerous analogous military and commercial applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-08

Date: February 1994

Budget Activity: 3. Advanced Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: FY 1994 new start.

(U) FY 1994 Planned Program:

- (U) Initiate program aimed at lowering the cost of polymer matrix composites via improved manufacturing processes. (\$3.8M)
- (U) Demonstrate networked infrastructure linking computer-aided design, engineering, and analysis with manufacturing systems. (\$2.9M)

(U) FY 1995 Planned Program: FDAMMS New Start

- (U) Complete baseline and technology insertion assessment studies to determine key leverage points to lower total costs and cycle times for High Performance Electro-Mechanical (HPEM) devices such as missile/munition seekers. Assessments will include dual-use commercial technology. The baseline studies will provide quantitative basis and metrics for the FDAMMS ATD evaluation. Identify and define service design exercises to evaluate new tools and factory processes and develop the user links for the manufacture of advanced flexible manufacturing pilot factories using existing advanced manufacturing processes and tools that are currently available. Identify new tools and methods that will need to be developed in parallel research efforts in advanced engineering tools and flexible factory technologies. In FY 1995/96 these pilot factories will simulate new manufacturing capabilities to assess the effectiveness of factory system design. These factories will integrate product/process (IPPD) design tools for application to infrared seekers and will include an electronic information infrastructure to facilitate the development of a manufacturing enterprise. (\$8.5M)
- (U) Begin the development of advanced engineering tools, methods, and processes for the HPEM devices with application to missile seekers. Release research contracts for the development of advanced cost analysis and risk assessment tools and methods for design and production of HPEM devices including missile seekers. This

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-08

Date: February 1994

Budget Activity: 3. Advanced Development

work will be the collaboration of industry, university, vendor and government laboratories. (\$3.8M)

(U) Program to Completion:

- (U) Complete demonstration of design and manufacturing of missile/munition seekers in prototype flexible, multi-product factory.
- (U) Transition design tools and factory control systems for application to a broad range of HPEM applications in military and commercial markets.

D. (U) WORK PERFORMED BY: Contractors will be selected competitively. In-house work will be performed by U.S. Air Force Wright Laboratory; Naval Air Systems Command; U.S. Naval Research Laboratory; U.S. Army Missile Command; U.S. Army Research Laboratory; and National Institute of Standards and Technology.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Revised to reflect cancellation of the AESA program and delayed initiation of the FDAMMS program to FY95.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: These programs complement ongoing ATDs in Rapid Prototyping of Application Specific Signal Processors (RASSP) and Infrared Focal Plane Array Flexible Manufacturing (IRFPA-FM). FDAMMS will build upon ongoing work in the MADE program.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan Milestones

Apr 95 Initiate Pilot Flexible Factory Development contracts.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing
Technology

Project Number: MT-08

Date: February 1994

Budget Activity: 3. Advanced Development

Jun 95	Initiate Advanced Engineering Tool Development contracts.
Jun 96	Complete development and alpha test of advanced CAD tools, process planners and simulation models. Demonstration of design system application to low end missiles.
Jun 96	Simulation demonstrations of advanced manufacturing capabilities.
Sep 96	Flexible factory simulations completed.
Jun 97	Initiate development of design systems and flexible factory systems for FDAMMS.
Sep 99	Deliver final versions of hardware and manufacturing equipment and processes, and transfer technology for both military and commercial use.
Dec 99	Complete demonstration of manufacturing pilot factory and advanced tools and technologies.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-09 (New Start) Date: February 1994

PE Title: Electronics and
Manufacturing Technology

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Dual-use Design and Manufacturing

Popular Name	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Program
MT-09									
Dual-use Design and Manufacturing Technology	0	0	25,180	44,742	46,751	34,235	15,000	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES: An essential element of the new defense strategy is dual-use manufacturing. DoD will increasingly rely on commercial production lines to produce military variants of their products for incorporation into weapon systems. This project focuses on the flexible process technology including advanced design systems, scalable components and subsystems, advanced materials and processing, flexible factory systems and manufacturing operations control needed to implement this strategy. The program will initiate two sub-projects, Interferometric Fiber Optic Gyroscopes (IFOG) and Manufacturing Systems Technology for Electric Drive Systems (MSTEDS) in product areas with a potentially large commercial market. The emphasis will be on achieving the design and manufacturing flexibility required to make low volume Defense access to high volume commercial production economically viable.

(U) Interferometric Fiber Optic Gyroscopes (IFOGs) are emerging as preferred technology for future commercial inertial navigation applications. The Low Cost IFOG Manufacturing project will develop the large throughput robotic assembly, packaging and testing technologies necessary to fabricate miniature navigation-grade (1 nm/hr) IFOG inertial measurement units (IMUs) at <\$2500 per axis as a goal. Miniature navigation-grade IMUs are essential to precision strike weapon systems required to accurately navigate through extended periods of Global Positioning System (GPS) outage due to enemy jamming. Example technology development areas include: (1) low loss, low reflectivity, polarization-preserving optical connectors between optical fiber subassemblies, and optical sources, detectors and miniature integrated optical circuits (MIOCs); (2) rapid,

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics and
Manufacturing Technology

Project Number: MT-09 (New Start) Date: February 1994
Budget Activity: 3. Advanced Development

precision coil winding machines; (3) geometrically stable, environmentally robust (temperature and vibration) packaging of critical optical subassemblies; (4) large volume Miniature Integrated Optical Circuit foundry processes; and (5) automatic testing machines.

(U) The above areas have been identified due to their current dependence on specialized technical labor or because of more stringent requirements for navigational grade gyroscopes as compared with current tactical grade gyroscopes. The current manufacturing technologies for coil winding and multifunction integrated optical circuits fabrication are too slow, too labor intensive and too inconsistent. Improved processes and process controls will be required to lower cost and improve quality.

(U) The Manufacturing Systems Technology for Electric Drive Systems (MSTEDS) demonstration targets electric drive systems between 20-750 horse power (HP) for demonstration of advanced design and dual-use manufacturing systems. These devices have broad use in DoD and commercial applications and provide a current application for demonstration of dual-use factories. The project will demonstrate Integrated Product/Process Design systems that will integrate performance and manufacturing process requirements for new designs prior to prototyping; factory simulation systems; physics-based models and control systems for processing advanced materials; advanced cost models; flexible factory planning and control systems for low cost automated manufacture of advanced electric drive systems. This project will leverage significant anticipated industry investment through cooperative efforts which integrate DoD high performance requirements with commercial requirements for low-cost, rapid response and reliability. Dual-use objectives will require concentration on families of subsystems and components designed from the start for flexible manufacturing, and on flexible factory systems.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program: None.

(U) FY 1994 Planned Program: None.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-09 (New Start) Date: February 1994

PE Title: Electronics and
Manufacturing Technology

Budget Activity: 3. Advanced Development

(U) FY 1995 Planned Program:

- (U) Competitive awards for innovative integrated process and product development of components of motors and motor controllers, including design tradeoffs, simulation of component behavior, and planning of flexible manufacturing processes. (\$3.0M)
- (U) Develop new flexible manufacturing, factory control reference architectures, factory models, and intelligent manufacturing resource planning systems. (\$4.0M)
- (U) Develop innovative materials-based and physics-based manufacturing process models for motor drive components. (\$3.0M)
- (U) Simulation based design of electric drive systems for aircraft, land combat vehicles, and maritime systems; and prepare specifications for prototypes of electric drive parts and assemblies. (\$2.3M)
- (U) Conduct Interferometric Fiber Optic Gyroscope (IFOG) Manufacturing Requirements Assessment. Initiate technology developments for precision robotic interconnection of IFOG optical parts and subassemblies; for environmentally robust, optically stable IFOG component and subassembly packaging facilities; for rapid, precision coil winding machinery; for large batch processing Multifunction Integrated Optical Circuit foundry; and for automatic test equipment (\$12.9M)

(U) Program to Completion:

- (U) Construct and complete a prototype IFOG manufacturing facility.
- (U) Demonstrate low-rate of production IFOG Inertial Measurement Unit manufacturing.
- (U) Transition Interferometric Fiber Optic Gyroscope manufacturing technologies to defense and civilian contractors.
- (U) Demonstrate economic viability of flexible production of electric drive systems for military and commercial markets.
- (U) Transition Manufacturing Systems Technology for Electric Drive Systems (MSTEDS) flexible manufacturing technologies for use in dual-use electric drive factories and for other multi-product manufacturing applications.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E
PE Title: Electronics and
Manufacturing Technology

Project Number: MT-09 (New Start) Date: February 1994
Budget Activity: 3. Advanced Development

D. (U) WORK PERFORMED BY: This is a new start in FY 1995. Contractors will be selected by competitive awards.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Not applicable.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: The programs complement the Hybrid Electric Drive (Alternate Propulsion) project.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Apr 95	Award Interferometric Fiber Optic Gyroscope (IFOG) manufacturability contracts.
Jun 96	Initial demonstrations of IFOG design systems and critical manufacturing processes.
Oct 98	Demonstrate IFOG prototype flexible factory systems.
Apr 99	Deliver final versions of IFOG hardware and manufacturing equipment and processes, and transfer technology for both military and commercial use.
May 99	Demonstrate Manufacturing Systems Technology for Electric Drive Systems (MSTEDS).

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: **#0603739E**

Project Number: **MT-10** Date: **February 1994**

PE Title: **Electronics Manufacturing Technology**

Budget Activity: **3. Advanced Development**

A. (U) RESOURCES: (\$ In Thousands)

<u>Project Title:</u> Advanced Lithography									
Popular	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	To	Total
<u>Name</u>	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Program</u>
MT-10	Advanced Lithography								
	*71,273	58,386	10,000	25,000	25,000	25,000	25,000	Continuing	Continuing

*Funded under PE 0602712E in FY 1993 and prior years

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Lithography technology has enabled the dramatic growth of integrated circuit (IC) capability over the past two decades. Advances in lithography lead directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability. Advanced microelectronics technology is essential for computing, data and signal processing, and communications for both civilian and military needs. Specific defense applications include smart weapons, radar, electronic warfare, sensing, communications, command and control, and surveillance. Further improvements in areas such as target recognition, autonomous guided missiles and beam forming for sonar and radar will require microcircuits with smaller features in order to meet the power, weight and volume constraints of these systems.

(U) Current microelectronics manufacturing utilizes 0.5 micron minimum feature sizes. This effort develops subsystems and systems to establish manufacturing capability at 0.18 - 0.1 microns for late 1990s manufacturing. Because the optimal cost-effective lithography approach for these future generations of technology is not known today, this effort balances investment in competing approaches with a strong emphasis on the common cross-cutting techniques that will be required. Key developments include mask technology (electron-beam tools for pattern writing, mask fabrication demonstration, mask repair tools, and membranes), improved alignment and overlay techniques, metrology, systems development and integration utilizing various radiation sources

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-10

Date: February 1994

Budget Activity: 3. Advanced Development

(x-ray, electron-beam, ion-beam, and optics), and device demonstrations to establish viability of the developed systems.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Use x-ray lithography to fabricate 512K SRAM chips with 0.25 micron gate lengths.
- (U) Evaluate diode pumping for the laser plasma x-ray source.
- (U) Develop a multi-shot power supply for the focus plasma x-ray source.
- (U) Complete mask repair tool for masks with 0.25 micron features.
- (U) Release a standard configuration for x-ray masks.
- (U) Initiate efforts in ion-beam and e-beam lithographies directed at prototype systems for 0.18 micron features.

(U) FY 1994 Planned Program:

- (U) Improve cross-cutting technologies (mask, alignment) leading to 0.18 micron design rules, including demonstration of a 50KV e-beam mask writer. (\$17.0M)
- (U) Initiate efforts to migrate the 0.25 micron aligners to 0.18 micron capability. (\$8.0M)
- (U) Continue efforts in ion-beam, e-beam, and advanced optical lithography, including characterization of the 193 nanometer exposure system. (\$9.5M)
- (U) Demonstrate 0.25 micron logic device fabrication with proximity x-ray and demonstrate pattern definition with improved projection x-ray system. (\$18.7M)
- (U) Extend X-ray technology into other applications such as coronary applications. (\$5.2M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-10

Date: February 1994

Budget Activity: 3. Advanced Development

(U) FY 1995 Planned Program:

- (U) Deliver EL-4 mask writer and demonstrate subsystems for 0.1 micron writer. (\$2.5M)
- (U) Develop overlay and processing capabilities for 0.18 micron design rules. (\$1.5M)
- (U) Complete design of step and scan system for projection x-ray. (\$1.0M)
- (U) Demonstrate subsystems for 0.18 micron tools in ion-beam and e-beam writer exposure systems. (\$5.0M)

(U) Program To Completion:

- (U) Demonstrate a "nanowriter" e-beam tool for writing zone plates with sub-50-nanometer features.
- (U) Demonstrate prototype projection e-beam and ion-beam lithography.
- (U) Demonstrate repair tool for repair of masks with 0.15 micron features.
- (U) Demonstrate stage control for lithography tools with 0.12 micron capability.
- (U) Fabricate devices using soft x-ray reduction techniques.

D. (U) WORK PERFORMED BY: IBM, Essex Junction, VT; ETEC, Hayward, CA; University of Wisconsin, Madison, WI; ALG, Rockville, MD; Lockheed-Sanders, Nashua, NH; AT&T, Murray Hill, NJ; SVGL, Wilton, CT; and Lawrence Livermore National Lab, Livermore, CA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Consistent with FY 1994 Descriptive Summary.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Not applicable.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-10 Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Jun 94	Characterize 193 nanometer optical lithography tool.
Aug 94	Deliver masks from the Microlithographic Mask Development Program.
Jun 95	Demonstrate mask repair tool for masks with 0.15 micron features.
Dec 95	Demonstrate a "nanowriter" e-beam tool for writing features at 50 nanometers.
Sep 96	Fabricate devices with 0.18 micron features.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

Project Number: MT-11 Date: February 1994

PE Title: Electronics Manufacturing Technology

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Computer-aided Acquisition and Logistic Support (CALS)

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MT-11 Computer-aided Acquisition and Logistics Support (CALS)	0	43,000	40,000	20,000	15,000	15,000	0	0	133,000

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Computer-aided Acquisition and Logistic Support (CALS) is a joint DoD/industry initiative for the transition to electronic interchange of technical and business information over wide area networks (the "information highway"). This transition will require sophisticated implementation of technology, standards and advanced business practices across a broad, integrated civilian-military industrial base. Implementation will involve prime contractors, government activities, and tens of thousands of small and mid-sized manufacturing enterprises over the next five years. The CALS Shared Resource Center (CSRC) program responds to the need to provide technology deployment and implementation assistance to these enterprises in the area of CALS and electronic commerce. The CSRC program will provide technology access, demonstration projects, training, consulting and implementation assistance as part of a nationwide network of extension services.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) FY 1994 new start in RDT&E. (Prior effort part of Air Force O&M).

(U) FY 1994 Planned Program:

- (U) Transfer cognizance for the CSRC program from Air Force to ARPA.
- (U) Establish a new contract or other agreement for continuation of the original CSRC activity as the Department's tri-service CALS standards and technologies

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-11 Date: February 1994

Budget Activity: 3. Advanced Development

- development, deployment, training and education hub; and establish three new CSRC Regional Satellites as directed by Congress. (\$23.0M)
- (U) Continue operation of the six original CSRC Regional Satellites as directed by Congress, and establish links to related technology deployment activities. (\$20.0M)

(U) FY 1995 Planned Program:

- (U) Continue CSRC hub activities; develop additional training courses and train instructors for the CSRC Regional Satellites and other manufacturing extension service providers in the nationwide network; enable network access to the online CALS library and to expert consulting services; conduct development, demonstrations and tests of CALS technology, standards and software focused on manufacturing and logistics applications; support DoD and industry groups in CALS outreach forums; demonstrate feasibility of mechanisms to increase the non-Federal cost share for the CSRC program. (\$20.0M)
- (U) Continue CSRC Regional Satellite activities; expand the depth of specialized expertise unique to each node through technology demonstration projects; increase the number of small and mid-size enterprises in each region reached through CSRC outreach activities; provide training and technical assistance for regional clients in implementing CALS and electronic commerce; demonstrate an initial range of services and information available to other extensions service providers in the nationwide; demonstrate the feasibility of mechanisms to increase the non-Federal cost share for operating the regional satellites. (\$20.0M)

(U) Program To Completion:

- (U) Complete initial demonstrations and pilot programs for implementation of CALS and electronic commerce; update technology plans, standards, training courses and assistance services to reflect lessons learned; transition CSRC extension services to become largely self sustaining elements of a continuing manufacturing extension program beyond RDT&E.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing Technology

Project Number: MT-11 Date: February 1994
Budget Activity: 3. Advanced Development

D. (U) WORK PERFORMED BY: The CSRC hub activity is the Concurrent Technologies Corporation, a nonprofit institution in Johnstown, PA. The existing CSRC Regional Satellites are contracts with teams involving educational or nonprofit institutions, and/or small businesses. They are located in regions directed by Congress, including Scranton, PA; Palestine, TX; Orange, TX; San Antonio, TX; Dayton, OH; Cleveland, OH; and Fairfax, VA. New CSRC Regional Satellites will be established in 1994, as directed by Congress, with educational or nonprofit institutions in Oakland, CA; Atlanta, GA; and Bremerton, WA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Program based upon a Congressional transfer from the Air Force beginning in FY 1994.

F. (U) PROGRAM DOCUMENTATION: None.

G. (U) RELATED ACTIVITIES: This program is related to the DoD CALS Program (PE 0603736D), and will be closely coordinated with the OSD CALS Office. This program is also being closely coordinated with the Manufacturing Extension Program at the National Institute of Standards and Technology.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE:

Plan	Milestones
Feb 94	Transfer CSRC program from Air Force to ARPA.
Jun 94	Establish agreements for continuation of existing centers.
Sep 94	Establish three new CSRC Regional Satellites.
Sep 95	Complete initial demonstrations, show feasibility of non-Federal cost share.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603739E

PE Title: Electronics Manufacturing
Technology

Project Number: MT-11 Date: February 1994
Budget Activity: 3. Advanced Development

- Sep 96 Demonstrate value of networked access to CSRC services; implement mechanisms for non-Federal cost sharing.
- Sep 97 Transition CSRC activities to manufacturing extension program beyond RDT&E.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E

Date: February 1994

PE Title: Defense Reinvestment

Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Defense Reinvestment

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
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Defense Reinvestment

561,633	474,000	625,000	650,000	675,000	700,000	725,000	Continuing	Continuing
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B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The Defense Reinvestment program element is budgeted in the Advanced Development Budget Activity because its purpose is to stimulate development of technologies that will provide both new military capability and new commercial products, and further the integration of commercial and military production the potential for processes. Once developed and deployed, the resulting technologies will increase both national security and the national economy. The program's objectives will be achieved through the application of defense and commercial resources to develop dual-use technologies, provide manufacturing and technology assistance to small firms, and establish education and training programs designed to enhance U.S. manufacturing skills and target displaced defense industry workers. The program consists of multiple projects generally grouped into the following categories:

- Defense Dual-Use Critical Technology Partnerships
- Commercial-Military Integration Partnerships
- Defense Advanced Manufacturing Technology Partnerships
- Manufacturing Engineering Education Grant Program
- Manufacturing Extension Program
- Defense Dual-Use Assistance Extension Program
- Agile Manufacturing/Enterprise Integration Program
- Advanced Materials Synthesis and Processing Partnerships
- U.S.-Japan Management Training Program
- MARITECH
- Small Business Innovation Research

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E

PE Title: Defense Reinvestment

Date: February 1994

Budget Activity: 3. Advanced Development

(U) The FY 1994 program will fund the residual FY 1993 "highly recommended" proposals that could not be financed in FY 1993, and issuance of two new FY 1994 solicitations. The first will be another broad area announcement similar to the one issued in FY 1993, and the second will be focused in areas of critical importance to the technology base and infrastructure. Technology deployment (Manufacturing Extension Services) will be transitioned to DOC/NIST.

(U) The FY 1995 program continues the development programs and incorporates the Maritime Technology (MARITECH) initiative, a program to facilitate U.S. penetration of the commercial shipbuilding industry, while discontinuing the Manufacturing and Dual-Use Extension Programs. The FY 1995 program will solicit proposals from both broad announcements and focused area competitions.

(U) Funding for the Small Business Innovation Research (SBIR) Program is included within this Program Element in FY 1994-99 to strengthen the role of small business in meeting dual-use research and development for both military and commercial applications.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Published and distributed over 55,000 program information brochures and held 17 regional meetings throughout the U.S. to brief potential participants. More than 7,000 attended these meetings.
- (U) Established and staffed inter-agency proposal review teams and developed comprehensive guidelines for proposal evaluation.
- (U) Issued a solicitation for proposals in May 1993 and received approximately 2,800 proposals totalling over \$8.4 billion in response.
- (U) To date, 162 proposals were selected from 44 states, DC, and industrial collaboration between U.S. and 5 foreign countries.

(U) FY 1994 Planned Program:

- (U) Execute FY 1994 increment of ongoing FY 1993 projects.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603570E

PE Title: Defense Reinvestment

Date: February 1994

Budget Activity: 3. Advanced Development

- (U) Identify and establish new partnerships.

(U) FY 1995 Planned Program:

- (U) Execute FY 1995 increment of ongoing projects begun in FY 1993 and FY 1994.
- (U) Identify and establish new partnerships.

(U) Program to Completion: Continuing.

D. (U) WORK PERFORMED BY: Partnerships are composed of industry, federal laboratories, institutions of higher education, state government agencies, Government-owned and operated industrial facilities, and other entities that support the activities of the firms or non-profit research corporations.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: The FY 1995 program funding will continue promising research activities initiated in prior years, as well as funding new projects. Programmed FY 1995 funding continues Defense Reinvestment program activities at increased levels due to the highly successful execution of the FY 1993 program.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Ongoing government research projects.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

J. (U) MILESTONE SCHEDULE: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E
PE Title: Advanced Simulation

Project Number: SM-01 Date: February 1994
Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Advanced Simulation (National Guard)

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
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SM-01	Advanced Simulation (National Guard)	28,506	27,107	20,937	20,899	14,700	0	0	112,148
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B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: In FY 1992, Congress appropriated funds to initiate a program to apply advanced technology to the training of National Guard Roundout Brigades. This program was initiated to respond to issues that developed in the 1991 Desert Shield/Desert Storm mobilization and has now been integrated as an Advanced Concept Technology Demonstration.

(U) This program element is budgeted in the Advanced Development Budget Activity because its goal is to achieve a significant reduction in the time required to process reserve component maneuver forces through mobilization training in preparation for employment through the use of advanced distributed information technologies and innovative training strategies at a lower cost than current Active Component methods for conducting the same training. The intent is to develop and integrate technologies that enable National Guard soldiers to conduct sophisticated training either at the local community armory, or at the soldier's home. The program will capitalize on existing commercial technologies where feasible, and develop technologies where needed with dual-use potential.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Modified and moved Mobile SIMNETs to conduct Task Force operations.
- (U) Established a Reserve Component Virtual Training Center at Fort Knox, KY.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E

Project Number: SM-01 Date: February 1994

PE Title: Advanced Simulation

Budget Activity: 3. Advanced Development

- (U) Initiated development of an affordable table top battle staff synchronization trainer with associated software (JANUS-3D).
- (U) Developed synthetic terrain peculiar to testbed units for use in SIMNET and JANUS 3-D.
- (U) Initiated development of a reconfigurable ground vehicle simulator.
- (U) Initiated development of a location instrumentation and intervehicular communications technology (MIST -X).
- (U) Initiated development of new generation of measures of performance and measures of effectiveness (MOP/MOE).
- (U) Initiated development of program evaluation methodology.
- (U) Initiated development of desktop equipment simulators and advanced technology distributed training capabilities. Priorities were the maneuver battalion staff, forward support battalion staff, critical vocational skills of support personnel, brigade staff and small unit leaders. Developed compressed training programs capitalizing on distributed technologies.
- (U) Initiated modifications to armories to accept technologies.
- (U) Continued assessment of promising advanced technologies for integration into the program.

(U) FY 1994 Planned Program:

- (U) Connect two test brigades to the Defense Simulation Internet (DSI). (\$1.7M)
- (U) Continue development of reconfigurable ground simulator and conduct initial functionality test. (\$4.0M)
- (U) Conduct field trials of brassboard location instrumentation and intervehicular communications technology. Upon successful completion of trials, execute partial Phase II effort to develop and test prototypes in unit testbeds. (\$4.0M)
- (U) Continue development of desktop equipment simulators and advanced technology distributed training capabilities. Priorities will be on the maneuver battalion staff, forward support battalion staff, critical vocational skills of support personnel, brigade staff and small unit leaders. (\$4.6M)

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E

PE Title: Advanced Simulation

Project Number: SM-01 Date: February 1994
Budget Activity: 3. Advanced Development

- (U) Connect armories in the State of Iowa to the statewide fiberoptic network. (\$10.0M)
- (U) Continue development of measures and program evaluation research. (\$2.8M)

(U) FY 1995 Planned Program:

- (U) Operate two test brigades on the Defense Simulation Internet (DSI). (\$2.0M)
- (U) Complete Phase II development and assessment of location instrumentation and intervehicular communications technology. (\$6.0M)
- (U) Continue development of desktop simulators and advanced technology distributed training capabilities. (\$9.0M)
- (U) Continue development of measures and conduct of program evaluation research. (\$3.9M)

(U) Program to Completion:

- (U) Operate two test brigades on the Defense Simulation Internet (DSI).
- (U) Complete development of innovative training programs and assessment.
- (U) Complete development of prototype desktop simulators and advanced technology distributed training system.
- (U) Complete program assessment and write final report.

D. (U) WORK PERFORMED BY: Texas Instruments, Dallas, TX; Loral Corporation, Fort Knox, KY; Orlando, FL, Macon, GA, Seattle, WA; Hewlett Packard Computers, Orlando, FL; Silicon Graphics Inc., San Jose, CA; Sun Microsystems Inc., San Jose, CA; Houston Associates Inc., Arlington, VA, Boise, ID, Fort Leavenworth, KS; BDM Corporation, Monterey, CA, Fort Knox, KY, Fort Benning, GA, Camp Dodge, IA; SESCO Corporation, Arlington, VA; Northwestern University, Chicago, IL; and the Institute for Defense Analyses, Alexandria, VA.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Additional funds provided by the Congress for FY 1994 were applied to the one time effort to interconnect Iowa Armories and Reserve Centers.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E

PE Title: Advanced Simulation

Project Number: SM-01 Date: February 1994
Budget Activity: 3. Advanced Development

F. (U) PROGRAM DOCUMENTATION:

- (U) MOA (ARPA/STRICOM) 10/93
- (U) MOA (ARPA/Fort Knox/ARI/NGB) 2/94

G. (U) RELATED ACTIVITIES: Work in this area is coordinated with the Defense Modeling and Simulation Office (DMSO) which guides DoD policy and ensures that unnecessary duplication does not occur. Direct interaction exists between this program and the Army's TRADOC, FORSCOM, National Guard Bureau and DCSOPS. A Senior Advisory Group (SAG) monitors project performance, interested services send representatives to in-progress reviews and frequent briefings and Memoranda of Agreement coordinate actions. There is no unnecessary duplication of effort within the Army, ARPA or the Department of Defense.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None currently exist, but preliminary discussions regarding a joint project with the French and British are underway.

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Apr 94	Conduct brassboard evaluation Phase II MIST-x.
Jun 94	Award contract for MIST-x prototype development.
Jul 94	Delivery of proof-of-concept reconfigurable simulator.
Aug 94	Deliver prototype virtual reality equipment simulator.
Aug 94	Deliver first prototype advanced technology training programs.
Sep 94	Establish DSI nodes for two test brigades.
Feb 95	Deliver prototype digital library.
Feb 95	Continue delivery of prototype training programs and assessment tools.
Feb 95	Initiate delivery of prototype equipment simulators.
Feb 95	Field trials of assessment tools.
May 95	Deliver draft assessment measures and plan.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603744E

PE Title: Advanced Simulation

Project Number: SM-01 Date: February 1994
Budget Activity: 3. Advanced Development

Nov 95	Implement program evaluation program.
Nov 95	Begin delivery of prototype digital libraries and programs.
May 96	Implement assessment tools.
Aug 96	Send first experimental brigade to NTC.
Nov 96	Deliver modified training programs from FY 1996 NTC.
Feb 97	Deliver last equipment simulators.
Aug 97	Send second experimental brigade to NTC.
Feb 98	Deliver final report.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E
PE Title: Microelectronics
Manufacturing Technology

Project Number: EM-01 Date: February 1994
Budget Activity: 3. Advanced Development

A. (U) RESOURCES: (\$ In Thousands)

Project Title: Microelectronics Manufacturing Technology

Popular Name	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
SEMATECH	94,466	89,500	90,000	90,000	90,000	90,000	90,000	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: This program element is budgeted in the Advanced Development Budget Activity because it addresses the long-term semiconductor manufacturing requirements for both military and civilian applications. The goal is to continue reducing costs while maintaining the state-of-the-art in complexity and performance for silicon technologies. It will concentrate on future factory design and process definition and control efforts for flexible manufacturing of both low- and high-volume devices in the same factory. Environmentally conscious manufacturing, and safety and health of manufacturing personnel is also part of this effort. This project will also combine advances in physical equipment with software advances, i.e., fully integrated computer-integrated manufacturing (CIM) systems and modeling and simulation tools for designing processes, tools, and factories.

(U) The project builds on the prior SEMATECH effort funded in this project as well as the development efforts in the Microelectronics Manufacturing Science and Technology (MMST) contract in PE 0602712E. SEMATECH comprises the companies that supply the majority of the ICs used in defense systems, and it has a proven track record of working with equipment suppliers effectively. Therefore, SEMATECH will be the primary performer, with continued cost sharing from its member companies. In addition, a small portion of the funds in this project will support related longer-term efforts outside of SEMATECH that enhance the overall goal of achieving cost effective semiconductor manufacturing.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E
PE Title: Microelectronics
Manufacturing Technology

Project Number: EM-01 Date: February 1994
Budget Activity: 3. Advanced Development

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Initiated projects to produce equipment, materials and factory control systems that will enable the manufacture of high-quality 0.25 and 0.18 micron semiconductor devices.
- (U) Established new technical thrusts in computer modeling and contamination-free manufacturing to extend process capability.
- (U) Expanded development of pollution-preventing, environmentally safe manufacturing processes to drive additional process capability.

(U) FY 1994 Planned Program:

- (U) Finish 0.25 micron semiconductor manufacturing technology process definition.
- (U) Initiate projects for 0.18 micron semiconductor manufacturing process definition.
- (U) Fully integrate Environmental, Safety, and Health objectives into all technical programs.
- (U) Provide a broad program in materials that supports the next generation of wafer size.
- (U) Focus on increasing capital productivity and seek to reduce the cost penalty for low-volume manufacturers through SEMATECH's Future Factory Design program.
- (U) Integrate and leverage all the programs, in particular the long-range programs with universities and federal laboratories.

(U) FY 1995 Planned Program:

- (U) Develop key equipments and unit processes to enable 0.25 micron semiconductor manufacturing.
- (U) Demonstrate factory technology for automated production, including advanced process control.
- (U) Develop models and software that assist in the design of processes and equipment based on first-principles of physics.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E
PE Title: Microelectronics
Manufacturing Technology

Project Number: EM-01
Budget Activity: 3. Advanced Development

Date: February 1994

- (U) Optimize materials, processes, and equipment for low contaminant, robust manufacturing.
- (U) Demonstrate open factory integration platform for wafer fab, assembly, and test.
- (U) Initiate efforts focused on reducing the sensitivity of manufacturing cost to production volume.
- (U) Develop key components of factory systems capable of responding to process changes with first-pass success.

(U) Program to Completion:

- (U) Complete factory specifications for a 0.18 micron factory, including equipment, facilities and methods.
- (U) Complete the material optimization for low-contaminant robust manufacturing process chambers.
- (U) Optimize micro- and mini-environments for contamination-free manufacturing.
- (U) Demonstrate open factory integration platform for wafer fab, assembly, and test.
- (U) Demonstrate fully automated production, including closed-loop process control.

D. (U) WORK PERFORMED BY: The primary performer is the SEMATECH consortium in Austin, TX.

E. (U) COMPARISON WITH FY 1994 DESCRIPTIVE SUMMARY: Consistent with the FY 1994 Descriptive Summaries except that the semiconductor equipment portion has been moved to MT-01.

F. (U) PROGRAM DOCUMENTATION: Not applicable.

G. (U) RELATED ACTIVITIES: Not applicable.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603745E
PE Title: Microelectronics
Manufacturing Technology

Project Number: EM-01 Date: February 1994
Budget Activity: 3. Advanced Development

J. (U) MILESTONE SCHEDULE:

<u>Plan</u>	<u>Milestones</u>
Jun 94	Complete a strategy addressing key issues in environmentally safe semiconductor manufacturing.
Dec 94	Develop and transfer unit processes and generic manufacturing methods for integration into production facilities for 0.25 micron features.
Dec 94	Demonstrate operation of critical components of a distributed manufacturing system enabling incremental refinement and supporting tighter process control.
Dec 95	Develop and transfer software tools that reduce overall development cycles through application of modeling and simulation prior to hardware design and development.
Dec 95	Demonstrate the operation of key elements of a fully integrated advanced manufacturing system enabling maximum flexibility and rapid response to process modifications.
Dec 96	Develop and transfer unit processes and generic manufacturing methods for integration into production facilities for 0.18 micron features.
Dec 96	Transfer software tools that support flexible manufacturing.

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E

PE Title: Management Headquarters (R&D)

Project Number: MH-01

Date: February 1994

Budget Activity: 6. RDT&E Management Support

A. (U) RESOURCES (\$ In Thousands)

Project Number & Title	FY 1993 Actual	FY 1994 Estimate	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	To Complete	Total Program
MH-01 Management Headquarters (R&D)	21,362	26,266	28,718	29,618	30,269	30,323	32,349	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is budgeted in the Management Support Budget Activity because it provides funding for the administrative support costs of the Advanced Research Projects Agency. This funding provides for the personnel compensation and benefits for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1993 Program:

- (U) Funding under this program element in FY 1993 supported management and administration for the RDT&E program assigned to ARPA. The majority of the funds were required for the pay of personnel who operate the Agency. At the end of the year, additional end strength was transferred to ARPA.

(U) FY 1994 Planned Program:

- (U) ARPA will continue the basic management and administrative support functions for headquarters. The funding increase reflects the rental costs associated with the expansion of office space, additional personnel provided by the FY 1994

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FY 1995 RDT&E DESCRIPTIVE SUMMARY

Program Element: #0605898E

PE Title: Management Headquarters (R&D)

Project Number: MH-01

Date: February 1994

Budget Activity: 6. RDT&E Management Support

Appropriation Act, and the related support requirements necessary to adequately execute the increased responsibilities assigned to the Agency. It also finances the ramp up to the additional end strength provided in FY 1995.

(U) FY 1995 Planned Program:

- (U) ARPA will continue the management and administrative support efforts for headquarters at an increased level over FY 1994. An additional 28 billets have been added to ARPA in FY 1995.

D. (U) WORK PERFORMED BY: Civilian and military personnel assigned to ARPA and by ARPA agent personnel operating within the Military Services.

E. (U) RELATED ACTIVITIES: Not applicable.

F. (U) OTHER APPROPRIATION FUNDS: None.

G. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Not applicable.

UNCLASSIFIED